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CONGREGATION OF PLANETS IN THE WESTERN SKY DURING TWILIGHT, NOVEMBER 11, 1912.

LUIS G. LEÓN.

I take pleasure in communicating to the readers of POPULAR ASTRONOMY my observation of November 11 last, on which date the Moon, Venus. Jupiter and Mercury congregated in the western sky, in the constellation of Scorpio (Plate I Frontispiece.)

In the country village of *Coyoacan*, (ancient residence of Herman Cortez) where I now have my observatory, we have at this time of the year beautiful evenings, which really invite astronomical observations

The moon in its fourth day looked like a silver sickle; higher up was Venus, shining like the purest diamond; and to the right Jupiter looked pale compared with the Goddess of Love. Near the horizon was Mercury, but this planet was in the reddish part of the twilight, and could not be very easily seen, until darkness was almost complete.

The view was very fine, and even those persons who do not care much for the observation of Nature, looked towards the western sky with amazed eyes.

Coyoacan (near Mexico city,) Nov. 1912.

QUEEN VENUS.

Over the west an evening star is gleaming—
Day's work is done!
Over the east Auriga's queen is beaming—
Night has begun;
Brilliant and blue yon Harp's sun is declining,
Sinking to rest,
Whilst white and bright fair Venus still is shining,
Queen of the west!

CHARLES NEVERS HOLMES.

The Plymouth Inn.
Northampton, Mass.

ASTRONOMY AND THE NORMAL SCHOOL.

MARY E. BYRD.

A wide field and large opportunity await the normal schools that are first aroused to a sense of their duty in regard to elementary astronomy. According to the educational schemes of the day, they place much emphasis upon connecting students with the world about them, teaching them to become familiar with many forms of plant and animal life, and with the surface features of the earth in their vicinity. This is well. But it is not well to have elaborate courses of nature study with the sun in the heavens left out. It is not well that generations of children should grow up, knowing less about the stars than the negroes in Central Africa.

The ignorance that exists in regard to all things pertaining to the heavens over us is deplorable almost beyond the power of exaggeration. It envelops the country as the waters cover the sea. Intelligent, educated people do not know a planet from a star, or Venus from a comet, or whether the new moon is rising or setting. Few realize that the sun crosses the sky in a different path on each succeeding day, and fewer still connect these changes, constantly going on before their eyes, with the change of seasons. Indeed, it would be difficult to ask five questions about the heavenly bodies, so simple that two or three out of a company, generally well-informed, could make a grade of fifty per cent. For example, this is a true story. Not many summers ago, a party of visitors, at a pleasant island resort, were looking up at the stars one night, and a woman rather doubtingly ventured the opinion that the Big Dipper swings around the pole, but her husband, a yachtsman, wont to spend the night under the open sky, ridiculed the idea!

It would seem that the time had come for a renaissance in astronomical teaching, and where shall leaders be found if not in the normal schools? It is a vantage point in their favor that they are little hampered by old traditions and prejudices. One can hardly imagine their whole ideal for astronomy summed up in terms of a costly observatory, where a few might be instructed, the many only amused. Their chief duty is not to train astronomers, but rather to prepare efficient teachers for beginners. What shall the children learn is a vital question. If they are to find out about the sun, moon, and stars by using their own eyes, then those who are to teach must have large practice in observing directly, with the unaided eye.

The popular notion that astronomy and a telescope are inseparable is a fallacy. The human eye alone is no mean astronomical instrument—witness its achievements before the telescope was invented. It is certainly a convenient instrument. To employ effectively even the modest equipment of a small observatory often demands irksome preliminaries and laborious adjustments. Quick as thought the eye does our bidding, with an instantaneous glance it commands a widely extended field, and in a few moments compasses the entire dome of the sky. In laying the broad foundations of astronomical study, it is superior to the telescope. It gives a grasp of the whole subject. It shows the relation and connection of different parts, and yet without isolating them from the unity of the whole.

But there is one thing that is essential. The eyes must be trained. Seeing means far more than turning the head in a given direction, and allowing an image to fall on the retina. The beasts of the field can do that, and after that manner the multitude look up at the heavens, but they do not see them. Thus it is that many who visit observatories are disappointed. Crossing the threshold of the dome room and bringing the head close to a telescope do not give the seeing eye. It were as well to expect a single effort to make the right hand skillful or the ear appreciative of music. If, indeed, the sole end in view were to fit the student to use a telescope, it is doubtful whether better preparation could be devised than a comprehensive series of naked-eye exercises; and so it would seem as if those astronomers who look askance at the study of the constellations had not well chosen their ground of criticism.

Brief mention may be made here of another fallacious notion. It is commonly believed that by looking through a telescope, one may behold grandeur otherwise invisible. On the contrary, it is true that for no cunningly-fashioned optical instrument, but for our own eyes is spread the nightly feast of celestial beauty. The most wonderful view of the most powerful telescope pales into insignificance, when we look up and see, with no intervening glass, the glory of the whole heavens.

Next in importance to the oldest astronomical instrument, the unaided eye, there are a few mechanical appliances of large value for beginners. Why they receive recognition mainly by neglect is a puzzling problem; perhaps because they are simple and inexpensive. And yet one might suppose that such tools would be the very ones to employ in training teachers and to pass on later to younger pupils. Doubtless normal schools could immeasurably advance sound astronomical instruction, if they themselves would show by precept and in practice sincere appreciation of such simple things as protractors plumb lines, gnomon and sundial. Anyone without experience has little inkling of their far-reaching possibilities, how aptly they can be

used in scientific training, and how much meaning they put into different subjects. What a flood of light will pour in upon some of the dark places of arithmetic and geography, when it is a part of the regular course for boys and girls to find the latitude of the school building by measuring the height of a gnomon, and the length of its shadow, and to determine the error of the clock from a reading of the sundial or by noting the transit of a star across plumb lines. A whole book, almost, might be written on the "Plumb Line as an Astronomical Instrument."

It ought not to be considered heterodox to apply to astronomy the exact methods of other sciences. Text-books need not be discarded nor the magic lantern barred. But the limitations of both must be recognized. Desultory star-gazing must give place to an orderly procedure in observing, with definite aims, continuity of effort, and proper coördination with books, maps, almanacs, and globes. In a word, the scheme of practical work in astronomy should be as well articulated, broad in scope, and rigorous in treatment as the laboratory courses in physics and chemistry. Not that for a moment, one would wish to reduce celestial observing to a set, mechanical routine. It is to be feared that laboratory courses sometimes have their vitality sapped because of their finality and dry uniformity. This is, however, a danger that is not imminent in astronomy. The clouds alone block any treatment of the martinet type, and even if clear skies could be commanded at will, it would still be impossible to frame a completely detailed course that would be satisfactory for two consecutive years. It is common to speak of the unchanging heavens, the sun and the stars forever the same, and in a sense this is true; but when account is taken of varying phases of the moon, the paths of wandering comets, and the kaleidoscopic effects of planetary motion, it is also true that the heavens are forever changing.

In science the by-product is sometimes of more value than that which is sought directly, and so, even though laboratory methods are applied to the study of the stars, there will be no less room for feelings of pleasure, wonder and reverence. It is not inimical to the true spirit of science to teach children so that they may enjoy watching the sky at evening, recognizing the planets, picking out the leaders among the stars, Sirius, Arcturus, Capella, Aldebaran, and going over the roll of familiar constellations, whose very names are melodious, and whose histories were replete with myth and legend before Job questioned "Canst thou bind the sweet influences of the Pleiades or loose the bands of Orion?"

At the shrine of the stars our human race first learned to worship, and it is the inalienable right of each succeeding generation to kindle at the same source its beacon lights of faith and aspiration.

THE PERIOD AND VARIATION OF α ORIONIS.

JOEL STEBBINS.

The bright star *Betelgeuse*, which is such a conspicuous object in the winter sky, was suspected of variability by Sir John Herschel, who announced his discovery in 1840. Since that time a multitude of observers have watched the object with curiously discordant results.

This star has been a favorite inasmuch as no instrument is necessary to observe it, and one has only to look up in the sky and see for himself the character of the light changes. However, in looking over the literature which has accumulated, one soon becomes convinced that the record is one of differences between observers and changes of the same observer, in addition to the variations of the star. Special attention was drawn to this object in the fall of 1902, when many observers agreed that the star was unusually bright, perhaps half a magnitude or more above normal. It is an interesting psychological fact that while a sudden brightening of such a star will cause scores of astronomers and laymen to watch it carefully, an equally conspicuous decrease in light occasions little or no comment. From every conceivable scientific standpoint a minimum is just as important as a maximum. During the season of 1910-11 α *Orionis* was twice at a faint minimum, being to my eye equal in color and intensity to α *Tauri*, and though this happens perhaps only once in a half dozen years no particular notice was taken of it. In America the event was marked by Seagrave,* but his is the only note that has come to my attention.

It is significant that even when the changes of *Betelgeuse* are conspicuous few observations will be found contributed by those observers who are continually active on other variables, and this can scarcely be because they have no interest in this object. It is acknowledged that estimates of the light of a red star are most difficult, especially when there are no other colored stars near it. In this case *Aldebaran* is a first class comparison star when *Betelgeuse* is faint, but when the variable is bright there is really no suitable comparison object in the sky. All experienced observers are aware of the difficulties under these circumstances, and no doubt they intentionally refrain from making or publishing estimates of the brightness of *Betelgeuse*.

* Popular Astronomy, **20**, 181, 1912.

Briefly, the more conspicuous changes which have been recorded for this star are these: J. Herschel observed it on different occasions from 1836 to 1840, and announced that the period was about one year. Following him we have Argelander whose observations extend from 1842 to 1871, from which he derived a period of 196 days. Argelander's successor, Schoenfeld, cast some doubt upon the regularity of this period, but gave no alternative. Another disciple of Argelander was Schmidt, who observed α *Orionis* with regularity for 40 years, 1843-1883. Most of his estimates were from comparisons with α *Tauri*, but he occasionally used β *Orionis*. His results for each year are summarized in the volumes of the *Astronomische Nachrichten*, though he gave only the dates of maxima and minima. The original comparisons are among his records which are deposited at Potsdam. In 1856 Schmidt stated that his results seemed to confirm Argelander's period of 196 days, though possibly it might be 10 days longer than this, but in 1864 he thought that the period must be longer than 300 days. Obviously if Schmidt himself could not find a definite period from his observations it would be difficult for any one else to do so. Another long series by Baxendell from 1837 to 1884 has recently been published and discussed by Plummer.* In the last thirty years there has been no comprehensive attempt to solve the riddle of *Betelgeuse*, and it seems striking evidence of the inadequacy of astronomical methods that the most conspicuous variable star of all has been before our eyes for 70 years, not to mention the previous centuries, and we have not been able to bring its changes under any describable law.

When I first undertook observations with the selenium photometer, the instrument was sensitive enough to show measurable effects for only the brightest stars, and for several years it seemed that the only variable which could be observed was α *Orionis*. Even in the preliminary experiments the measurement of this object seemed attainable, and it appealed to me that the perfecting of the instrument might be worth while just for the purpose of measuring this star. However, I had no confidence that the law of these changes could be derived in less than say 10 years. The first experiments with selenium were made in the latter part of 1906, and it was not until the autumn of 1909 that the instrument and its manipulation were perfected to an extent which made regular observations feasible. The methods then adopted are described in my paper on the *Algol* system.†

In February, 1909, there was an occurrence which set me on the track of what is necessary in working with selenium. A selenium cell

* *Monthly Notices* **71**, 701, 1911.
† *Astrophysical Journal*, **32**, 185, 1910.

had been mounted at the focus of our 12-inch refractor, and I had been forced to wait through a spell of cloudy weather before making some tests of the instrument. After a mild period, there came a "blizzard" with a high wind and a great drop in temperature, and after about a day the sky cleared, but the wind velocity remained at 30 to 40 miles per hour, and the temperature at —15° C. Under these conditions my assistant and I went to the Observatory hoping to take advantage of the clear sky. What was my amazement to find that not only did an exposure of the selenium to the light of a star produce at least twice the effect which had been anticipated, but also the irregular changes of the resistance of the selenium had decreased enormously at the low temperature. In terms of what the observer sees through the reading telescope of the galvanometer, the crosswire, instead of dancing to and fro along the scale by jumps of a centimeter or more, had become steady and remained within a range of less than a millimeter. In other words, the effective sensibility of the instrument had increased suddenly at least 10 times, and we had the experience of gaining a whole decimal place in a single night. It therefore seemed advisable to undertake a series of observations of some star, if only for the experience, and I therefore compared α *Orionis* with β *Orionis* and α *Tauri* on each clear night for about a month. During that interval, however, the selenium became more and more unsteady with moderating weather, and by the end of the month at a temperature of about + 10° C. the old trouble had returned and the observations were discontinued.

From previous laboratory experiments I had known that in spite of the increased resistance of selenium at low temperatures the light sensibility is much greater, but I was not aware that the irregularities would be so much less. It was therefore this sudden spell of cold weather which gave me the idea of keeping a selenium cell at a uniform low temperature. Some months afterward, Dr. F. C. Brown and myself succeeded in getting a cell mounted inside of an ice chamber with a suitable window for the entrance of light from a star, and since then the instrument has been more or less under control.

In the season 1909-10, my observing program did not allow much time for α *Orionis*, though measures were secured on a few nights, but in September 1910, I undertook to observe it frequently. Nevertheless, I was soon diverted to other stars, but the measures on *Betelgeuse* have been continued, it being my intention to observe it an intervals of 7 to 10 days, weather permitting.

As the observations with selenium are real measures of light intensity, which should be quite free from personal bias, we may expect that for such a bright star the results will exhibit an accordance which is much better than can be obtained in the conventional method of eye-estimates.

It may therefore be of interest to give the actual readings and the reduction of a set of measures. This sample has not been selected at random, but for the purpose of showing the procedure under poor conditions, as the sky was not of the best transparency, and a bright moon was near the stars.

TABLE I.

OBSERVATIONS OF α *Orionis*, WEDNESDAY OCTOBER 11, 1911.

Observers, J.S. and H.F.Z.
Cell, Giltay No. 93.
Ratio arms, 10,000 and 10 ohms.
Resistance of cell, 4,400,000 ohms.
Dome temperature, + 13° C.
Galvanometer, Weston.
Half millimeter scale at 2.2 meters.
Battery, 6 dry cells, 8.4 volts.
Exposures, 10 seconds.
Sky transparency, 3 on scale of 5.
Wind, northwest, light.
Watch ΔT, + 18 seconds.

Time	Readings	Deflections
	β Orionis	
16h 05m	249.9—310.5	60.6
06	277.4—337.8	60.4
		60.50
	α Orionis	
16 07 .5	286.5—323.1	36.6
08 .5	293.8—330.4	36.6
		36.60
	α Tauri	
16 10	291.1—321.0	29.9
11	299.0—327.2	28.2
12	302.1—330.5	28.4
13	306.6—335.2	28.6
		28.78

Time	Readings	Deflections
	α Orionis	
16h 14m.5	297.1—334.3	37.2
15 .5	308.8—345.1	36.3
		36.75
	β Orionis	
16 18	298.4—360.5	62.1
19	320.7—381.6	60.9
		61.50

REDUCTION.

Mean time	16h 12m		
Sidereal time	4 38		
Star	*β Orionis*	*α Orionis*	*α Tauri*
Deflection, D	61.00	36.68	28.78
Moonlight correction	— 0.70	— 1.00	— 1.30
Corrected D	60.30	35.58	27.48
Log D	0.780	0.552	0.439
Log. ratio to α *Tauri*	0.341	0.113	
Difference of Magnitude	0.85	0.28	
Tabular absorption	+0.10	+0.03	
Adopted absorption	+0.27	+0.08	
Corrected difference	1.12	0.36	

RESULTS ON OCTOBER 11, 1912.

Greenwich Mean Time	Difference of Magnitude from α *Tauri*		Absorption
	β Orionis	*α Orionis*	
h m	Mag.	Mag.	Mag.
22 12	1.12	0.36	+0.08
22 33	1.08	0.34	+0.06
Means 22 22	1.10	0.35	+0.07

The general accordance of the measures is indicated by the agreement of successive deflections from the same star. These deflections must be corrected for the effect of the bright moonlit sky, and a series of readings on the sky alone near α *Tauri* gave 1.30 scale divisions as the amount of this effect. β *Orionis* was farther from the moon, and measures here gave 0.70 for the same correction, while the value for α *Orionis* was roughly interpolated to be 1.00. For these bright stars the progressive drift of the galvanometer zero is ordinarily negligible. It is convenient to refer both β and α *Orionis* to α *Tauri*, the difference of magnitude being simply 5/2 times the common logarithm of the ratio of the deflections.

The most important and uncertain correction is that for atmospheric absorption. My practice is to multiply the value given in Müller's Potsdam table by a certain factor which varies from 1.0 to 2.0 or more, depending upon the character of the sky on the night in question. Where the final correction is only a few thousandths of a magnitude, the factor may be assumed, but for α *Orionis* it is quite desirable that the factor may be determined. Table II gives the absorption correction based upon Müller's table, and shows for the local station the amount that the absorption for each star exceeds that for α *Tauri*.

TABLE II.

DIFFERENTIAL ABSORPTION.

Sidereal Time	β *Orionis*	α *Orionis*	Sidereal Time	β *Orionis*	α *Orionis*
h	Mag.	Mag.	h	Mag.	Mag.
3.0	+0.16	+0.09	6.5	+0.10	0.00
3.5	+0.14	+0.07	7.0	+0.10	—0.01
4.0	+0.11	+0.05	7.5	+0.11	−0.03
4.5	+0.10	+0.03	8.0	+0.13	−0.05
5.0	+0.09	+0.02	8.5	+0.16	—0.08
5.5	+0.09	+0.02	9.0	+0.23	−0.11
6.0	+0.09	+0.01	9.5	+0.32	—0.18

On the basis of this table the procedure was as follows. From the measures on a number of the best nights, the corrected difference of magnitude between β *Orionis* and α *Tauri* was adopted to be 1.10 mag. In the example, at $4^h\ 38^m$ sidereal time, this measured difference was 0.85 magnitude, showing the actual absorption to be 0.25 magnitude as against 0.10 magnitude from the table. The absorption factor is therefore 0.25/0.10 = 2.5, which agrees with my judgment of the quality of the sky on that night. A second complete set of measures similar to the foregoing gave a factor 2.9, and the adopted mean was 2.7, and with this factor were made the corrections for α *Orionis*. Since α *Orionis* is always referred to α *Tauri*, the inclusion of β *Orionis* is only for the

absorption factor. In all strictness the factor is different for stars of various spectral types, but the selective effect is negligible in the present case. *β Orionis* also serves as a check upon the constancy of *α Tauri*, and, although each of these stars has been suspected of variability, I have found no evidence of change in the difference between them.

On each night two complete sets like the sample were taken, and the discrepancy of 0.02 magnitude is about the average, the probable error of the mean of two sets being of the order of 0.01 magnitude. This internal agreement of the measures is somewhat misleading, for the accuracy attainable is merely a question of the proper allowance for the absorption. Nevertheless it is certain that on good nights the selenium method gives results which are absolutely a whole decimal place beyond anything that my own eye is capable of by the method of direct estimates.

In table III are given the results thus far secured. The first crude measures in 1908 and 1909 are of some value and are therefore included. The difference of magnitude is uniformly the amount that *α Orionis* is brighter than *α Tauri*. The cases are noted where the absorption correction was more than 0.10 magnitude.

TABLE III.

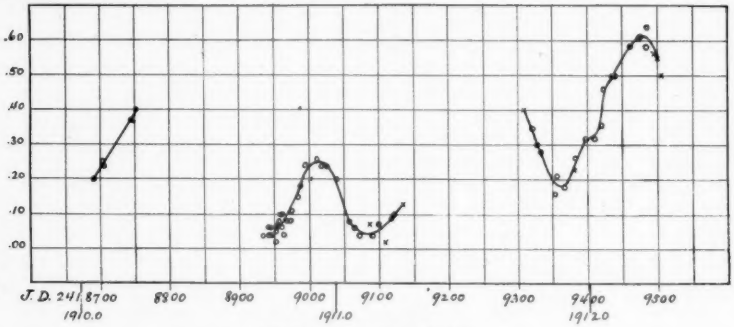
OBSERVATIONS OF *α Orionis*.

Date		J.D.241+	G. M. T. h	m	Difference of Magnitude Mag.	Remarks
1908 Jan.	23	7964	14	06	0.55	
	29	7970	14	26	0.53	
Feb.	3	7975	15	21	0.38	
1909 Feb.	1	8339	16	18	0.51	
	2	8340	16	11	0.58	
	4	8342	14	04	0.59	
	7	8345	14	56	0.63	
	10	8348	14	58	0.52	
	11	8349	14	48	0.56	
	16	8354	15	30	0.50	
	25	8363	14	36	0.55	
1910 Jan.	18	8690	17	53	0.20	Beginning of accurate measures
	31	8703	15	46	0.25	
Feb.	3	8706	14	08	0.24	
Mar.	14	8745	13	56	0.37	
	20	8751	13	42	0.40	
Sept.	20	8935	20	14	0.04	
	27	8942	21	50	0.04	
	28	8943	21	54	0.06	
	29	8944	21	59	0.06	
Oct.	1	8946	22	10	0.04	
	6	8951	21	58	0.02	
	7	8952	22	24	0.05	
	9	8954	21	52	0.06	
	10	8955	20	42	0.06	
	11	8956	20	38	0.08	
	13	8958	20	36	0.10	Absorption +0.13 mag.

Date	J.D.241+	G. M. T. h m	Difference of Magnitude Mag.	Remarks
14	8959	20 36	0.10	
16	8961	22 00	0.06	
18	8963	22 04	0.04	
22	8967	20 44	0.08	
28	8973	21 24	0.08	
30	8975	21 02	0.11	
Nov. 7	8983	19 34	0.15	
11	8987	19 45	0.18	
19	8995	20 12	0.24	
25	9001	21 46	0.20	Abs. −0.13
Dec. 7	9013	16 50	0.26	
11	9017	18 54	0.24	
20	9026	16 53	0.24	
1911 Jan. 3	9040	17 48	0.20	
22	9059	16 50	0.08	
29	9066	15 36	0.06	
Feb. 4	9072	14 10	0.04	
20	9088	13 59	0.07	1 set
24	9092	13 58	0.04	
Mar. 4	9100	13 27	0.07	3 sets
14	9110	14 50	0.02	Abs. −0.12
24	9120	13 18	0.09	Abs. −0.05
27	9123	13 22	0.10	Abs. −0.09
Apr. 9	9136	13 40	0.13	Abs. −0.20
Sept. 29	9309	22 23	0.40	1 set
Oct. 11	9321	22 22	0.35	
17	9327	22 27	0.30	
24	9334	22 32	0.28	
Nov. 12	9353	22 21	0.16	
15	9356	20 39	0.21	3 sets
26	9367	19 41	0.18	
Dec. 10	9381	18 25	0.23	1 set
13	9384	18 37	0.26	
27	9398	17 28	0.32	
1912 Jan. 8	9410	18 06	0.32	
18	9420	16 38	0.36	
22	9424	16 36	0.46	
Feb. 3	9436	15 39	0.50	
7	9440	15 35	0.50	
29	9462	14 42	0.58	
Mar. 15	9477	14 12	0.61	
24	9486	13 26	0.58	
25	9487	13 38	0.64	
Apr. 3	9496	13 38	0.56	Abs. −0.13
7	9500	13 44	0.55	Abs. −0.18
14	9507	13 58	0.50	Abs. −0.30, poor.

Beginning with J. D. 8690, the results in Table III are shown in the figure, on page 12 where circles represent the first class observations, and crosses those with only one set of measures or with absorption greater than 0.10 mag. I have drawn the light curve for the intervals where it is reasonably well determined. The facts established without possibility of doubt are, in Julian Days, an increase in light from 8690 to 8750, a maximum at 9015, and a minimum at 9361. With less certainty but still with great probability are shown a minimum at 9087, and a maximum at 9480. I can not say whether or not there was a minimum just preceding 8950. The observations immediately following 9400

were under such good conditions that the slight irregularity was probably real, though there remains the possibility that this was due to a change in *α Tauri.*



LIGHT CURVE OF α ORIONIS.

Let us now see what kind of a law we can get out of these observations. It is possible that we have to deal with changes in two periods; a relatively rapid oscillation of something like 0.2 magnitude superimposed upon one with a longer period and larger range, perhaps 0.5 magnitude. The interval between minima, 9087 to 9361 is 274 days, which might be either 1 or 2 times the short period. The first seems more probable, $P = 274$ days. From the maxima at 9015 and 9480 we have $2P = 465$ days, $P = 232$ days. Evidently if there is a mean period there are wide variations from it, and in round numbers we may adopt

$$P = 250 \text{ days.}$$

This outcome is about what I expected, and there seems no prospect that this period can be established before several years.

The case of the variation in a longer period is somewhat different. There is some evidence that *α Orionis* is a spectroscopic binary, and Bottlinger* has derived a rough orbit with a period of 6.0 years. He likewise has suggested that the light variations may be found to follow the same period. Plummer† has discussed this very question in connection with Baxendell's observations, and has found no evidence of a light variation in the assumed spectroscopic period.

I have tried selecting the observations made under the most favorable conditions, namely when *Betelgeuse* was nearly equal to *Aldebaran.* On the assumption that when the variable was noted as fainter than *Aldebaran* it was near a minimum in a 6 year period, provisional elements were derived to be

$$\text{Minimum} = 1911.2 + 6^{y}.1\ E.$$

* *Astronomische Nachrichten,* **187,** 33, 1911.
† *Op. Cit.*

The times of minima computed from this formula were in good agreement with my recent observations with selenium, and also with minima observed visually as far back as that of 1838 by J. Herschel. During this past summer while I was visiting the Potsdam Observatory, through the courtesy of Director Schwarzschild and Professor Mŭller I had the opportunity of looking over Schmidt's original estimates of *Betelgeuse*.

A superficial examination showed that he had observed the variable to be faint on many dates which were in direct contradiction to the assumed 6.1 year period, and the same is true of some of Argelander's and Baxendell's observations. Only a thorough rediscussion of these older series could bring out any new facts, and I am forced to the conclusion that little can be derived from the mass of material which has been collected for this star. It is not at all impossible that some such period as 6 years does exist, and in spite of the lack of evidence in the visual results, I am inclined to think that some law of the changes will ultimately be found.

My present conclusion, or rather guess, is that α *Orionis* may have one variation, more or less irregular, with a range of about 0.2 magnitude and period not far from 250 days; and also a slower variation the exact nature of which can not be stated.

Let us not forget that even if we do find the law of light variation, the problem of α *Orionis* is only touched. A light-curve in itself is merely a line on paper, and we ought to strive for some physical theory of the star which will give us a clew as to what causes the changes. This will have to be connected with the whole theory of the long period variables. Although the changes of *Betelgeuse* are slight, this star is so bright that its spectrum may be observed with great dispersion such as is being used at Mt. Wilson for other bright stars. It seems quite probable that a spectroscopic study in connection with a further determination of the light curve ought to produce new and valuable results. In any event I hope to continue these photometric measures for a number of years.

The observations described in this paper were taken at the University of Illinois Observatory, and I am indebted to Messrs. P. F. Whisler and H. F. Zoller for assistance in making the measures. I beg to thank also the Rumford Committee of the American Academy of Arts and Sciences for several grants in support of this and other photometric work.

Munich, Germany. Oct. 20, 1912.

THE DISTURBANCE IN THE NORTH TROPICAL BELT OF JUPITER.

A. THOS. G. APPLE.

In the latter part of August a rather unusual disturbance broke out in the belt of Jupiter immediately bordering the equatorial zone on the north. Comparatively rapid changes took place, spots breaking out at various points along the line of the belt, with a rotation period apparently more nearly that of System I than of System II. The first appearance of the disturbance was announced by Mr. Latimer J. Wilson in the November number of this Journal, together with the positions of a few spots. The belt has been observed at this observatory on 18 nights from Sept. 17, to Oct. 21, earlier observations having been prevented by the writer's absence from the city. The instrument used was an 11-inch refractor with filar micrometer. On ten nights measures were made to determine longitude, and on the remaining, eye-estimates were made when the spot in question was passing the Jovian meridian at the time of observation.

The conditions of seeing were never good, and often the worst, principally on account of the low altitude of the planet in the southwest. The longitudes are therefore not as reliable as those made earlier in the season when the seeing was better. The margin of error, however, we do not believe to be so great as to prevent drawing some conclusions like those given below. It was much to be regretted that the disturbance happened so near conjunction; but it is all the more important that early observations be made when the planet appears in the morning sky.

No special attempt was made to identify the several spots upon their reappearance. In a few cases identification seemed fairly certain; but in the majority the imperfect seeing, or the position of the spot in the obscure regions near the limb, rendered identification difficult if not impossible. The belt was therefore plotted upon successive parallel lines divided to degrees of longitude, and its course of development examined in its general features. The south tropical belt was also plotted upon the margin, that the position of the spots relative to the Red Spot and the S. Tropical Disturbance could be seen. As the bad seeing never permitted anything but the most general view of the shape of individual spots, no attempt at drawing has been made. The only detail is the curious split in the belt between u and v, seen on Oct. 10 This was not seen again, unless the confused darkening observed on the 15th through an unusually disturbed atmosphere was its reappearance.

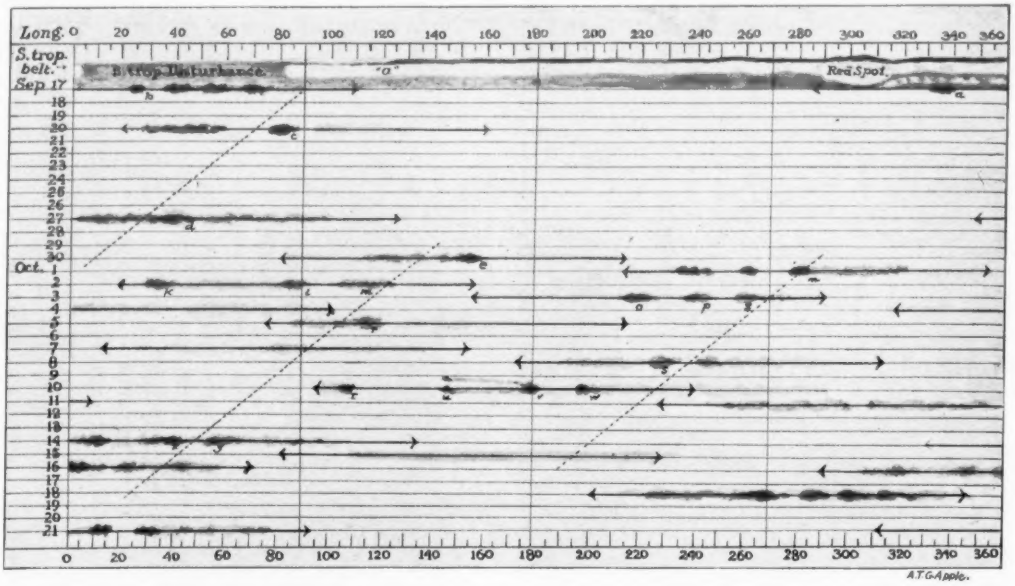


DIAGRAM OF THE N. TROPICAL BELT OF JUPITER SEPT. 17-OCT. 21, 1912.

On other days also, e.g. Oct. 4, 7, 11, 15, similar atmospheric disturbance prevented seeing all but the most general features, and therefore on the plot nothing of detail is attempted.

Without entering upon details, which will be apparent upon a study of the plot, there seem to have been three main regions of disturbance which on Oct. 1 occupied positions, roundly, in longitudes 10°, 135°, and 280°. These appear to have had a drift relative to System II indicated approximately by the dotted oblique lines. This would mean a rotation period of $9^h\ 51^m\ 40^s$ which would point to a connection with System I rather than System II. If these assumptions are correct, then the spot noted by Mr. Wilson Aug. 23 in longitude approximately 215° would belong to the first one of the three sections of disturbance, and would have drifted to about longitude 50° by Oct. 1. The planet was observed here on Aug. 20, when meridian 171° was about central and then no disturbance was noticed. On the above assumption, again, the spots indicated on Mr. Wilson's map (Popular Astronomy, November) are all either the same spot or members of one common disturbance. This is shown by the fact that their drift is approximately the same as that we have shown above. The "intensely dark spot in longitude 112°.3" noted on Oct. 7 would belong to another region, the third indicated on our plot.

The measured positions of the various spots are:

Sept. 17 a, 336.6°	Sept. 30 e, 154.3°	Oct. 8 s, 227.9°	Oct. 10 w, 197.5°
" " b, 25.1	Oct. 1 n, 281.4	" 10 t, 106.7	" 14 x, 40.5
" 20 c. 79.7	" 3 o, 229.0	" " u, 146.0	" " y, 57.0
" 27 d, 38.9	" 5 r, 115.1	" " v, 179.2	

The whole course of these changes reminds one very much of Professor Barnard's description of a belt "just north of the N. tropical belt," observed by him in November 1880 in Nashville Tenn.* At that time the equatorial region was occupied by a broad dark belt with darker borders on the N. and S., and the belt in question was to the north of this. The outbreak as pictured and described was very much like the one just witnessed, and it is noteworthy that the latitude was not so very far from that of the present disturbance. Unfortunately at that time the weather was too bad for any reliable measures of rotation, but from his observations he concludes concerning the rotational motions of the spots that "it was clearly evident that they were extremely rapid."

In addition to the above observations on the N. Trop. belt, measurements for longitude and latitude were made of four principal points on the surface of Jupiter throughout the season of his appearance. These points were,—the Red Spot, (Plate II Fig. 1.) the beginning and the

* Pub. Ast. Soc. Pac. No. 5, pp. 100 ff.

PLATE II.

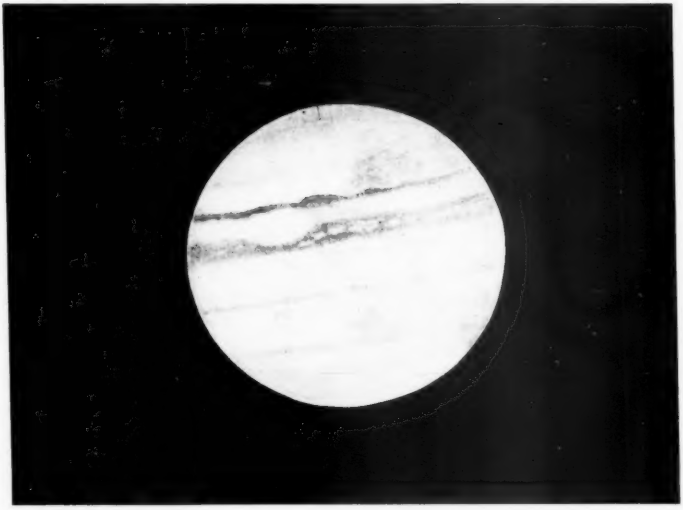


FIG. 1. JUPITER, JUNE 5, 1912, 10:45 W. M. T.

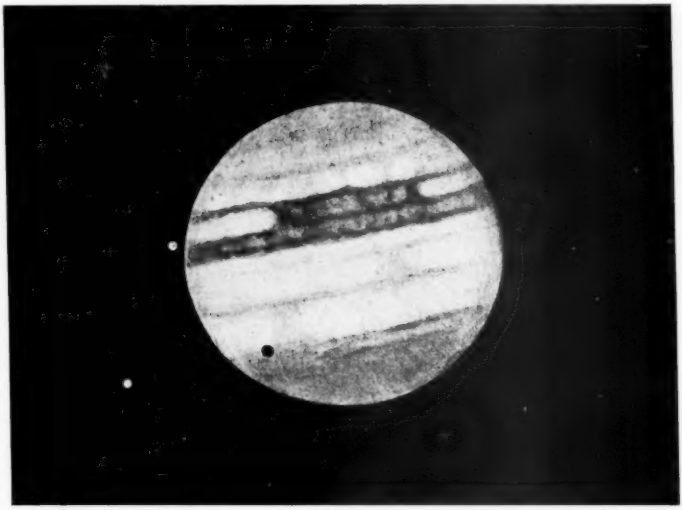


FIG. 2. JUPITER, JULY 2, 1912, 10:05 W. M. T.

PLATE III.

JUPITER, JUNE 1, 1912, 12:40 W. M. T.

end of the S. Tropical Disturbance (Plate II, Fig. 2.) ,and a point in the S. Temp. belt where the belt suddenly breaks off and continues as a fine double line, which continues in a preceding direction to the "Disturbance", into which it merges. Mr. Wilson has represented this feature in the first one of his maps, in longitude 165° and latitude 27° S., although the termination of the dark portion as seen here was more distinct and decided, and tapered to a point. We have denominated it "a" (Plate III.) There was no evidence of a change of latitude in the belts, the mean values found being:

Red Spot, ...	20°.8 ± 0°.25	9 measures.
S. Trop. Disturbance	20°.7 ± 0°.47	12 "
Point "a"	25°.4 ± 0°.23	10 "

The longitudes of these three points show a nearly uniform eastward drift, most rapid in the case of "a", slowest in the case of the Red Spot. The following are the longitudes. The column "h" shows the difference in time between the mean of the times of the settings of each measure (usually ten) and the time of transit across the Jovian meridian.

Date	p. STD. h	long.
	m	°
Feb. 29	+17.6	77.5
Mar. 29	−11.6	64.0
" 31	+51.0	60.3
Apr. 23	−57.7	55.3
May 2	−26.9	60.0
" 31	0.0	44.5
June 1	+ 7.9	45.3
" 3	− 3.1	43,3
" 10	− 1.0	41.6
July 1	+32.9	34.7
" 2	− 3.1	33.8
" 9	+19.3	29.6
" "	0.0	30.2
" 19	+ 5.2	27.3
" 26	+15.0	21.7
Aug. 12	−35.0	19.3
" 14	+ 1.1	14.6
Sept. 17	− 6.8	2.5
Oct. 11	+18.7	344.3
" 16	−12.3	340.9

Date	f. STD. h	long.
	m	°
Mar. 25	−25.5	131.6
Apr. 23	+17.4	117.3
June 1	−59.6	109.2
" 3	+19.5	108.5
July 2	+ 2.2	100.7
" 5	−12.9	93.6
" 12	−20.0	97.1
Aug. 5	−21.3	89.6
" 15	−37.8	86.3
Sept. 20	− 8.6	81.0
Oct. 2	eye-est.	68.8

Date	"a" h	long.
	m	°
May 10	−12.0	201.9
" 13	−65.1	194.5
June 1	− 9.0	189.4
June 28	− 8.6	172.7
July 1	−24.9	177.1
" 3	− 2.8	176.0
" 22	−38.6	158.3
" 27	− 0.9	155.7
Aug. 3	−40.5	148.0
" 5	− 4.5	149.1
" 13	−62.3	151.7
" 15	−11.1	148.2
" 20	−13.7	145.2
Oct. 5	−38.9	112.6

Red Spot		
	m	°
Apr. 19	−17.9	304.6
May 2	−26.9	308.6
" 28	+15.6	309.2
" 31	−14.1	314.5
June 9	+13.1	310.7

Red Spot		
	m	°
July 1	− 4.6	306.4
" 8	+ 2.1	306.3
" 13	− 5.8	303.8
" 25	+ 2.4	300.5
Aug. 14	−46.0	308.2

Red Spot		
	m	°
Aug. 16	− 3.7	300.7
Oct. 1	+28.2	297.5
" 11	−24.3	295.3
" 18	+21.0	289.8

The value of the polar compression which resulted from forty-eight separate measures of latitude and longitude, each measure consisting usually of ten settings, was 1/16.03 ± .0012.

An interesting sight was the transit of satellite I on the evening of June 1. It was only 18 hours after opposition. The seeing was unusually good and the satellite could be followed the whole of its course across the planet's disk, accompanied by its shadow, which it partly covered, allowing only a narrow black crescent to project beyond it on the south following side.

Daniel Scholl Observatory,
Lancaster, Pa., November, 1912.

THE SCIENTIFIC WORK OF THE CINCINNATI OBSERVATORY.*

ELLIOTT SMITH.

Of the people who gave names to the constellations we have little or no knowledge, but many of these names will be recognized as belonging to the heroes of ancient mythology. Great were the deeds of these heroes which should entitle them to a place in heaven among the gods. Viewing the sky on a clear night at this time of year we see the well-known constellations Orion, Hercules, Taurus, Cygnus, Andromeda and others. I would call your attention in particular, however, to a small constellation that may be seen in the evening just west of our meridian —the constellation Lyra. Ancient mythology tells us that this is a wonderful musical instrument, given a place among the gods because of the sweet harmony of its music. The wonderful stories told of this instrument in the hands of the hero musician need hardly be related here. Suffice it to say that its music led the king of the Infernal Regions and the Fates to do the hero's bidding and moved rocks and trees to tears.

But fact is stranger than fiction and, relying on their observations, astronomers tell us truths concerning our relation to this constellation that far surpass in wonder and grandeur the tales of mythology.

The most eminent astronomer of our day once said that, if asked what the greatest fact is that the intellect of man has ever brought to light, he would say it is this: "Through all human history, nay, so far as we can discover from the infancy of time our solar system—sun, planets, moons—has been flying through space toward the constellation Lyra with a speed of which we have no example on earth." The

* One of several short addresses delivered at the dedication of the O. M. Mitchel Building of the Cincinnati Observatory Oct. 29, 1912.

swiftest cannon shot is a snail's pace in comparison. In the time that it takes the business man to go from his down town office to his suburban home we advance toward this constellation a distance equal to the circumference of the earth. We are approaching it at the rate of ten miles a second, nearly a million miles a day. Yet so vast is the space through which we travel that, if prehistoric man were to appear on the earth today, the constellations we are approaching would appear no different to him now than they did in his own time. If after ages of travel we were to arrive in that region of space now occupied by this constellation we have no assurance that its stars would be there. Indeed we can say almost with certainty that they would not be. Vega, the bright star of this constellation, is known to be moving away from its present position with a velocity equal, at least, to that with which we are appproaching it.

Not only are Vega and our sun moving through space with great speed but in all probability every other star in the universe as well. The velocities .range from a few miles per second up to the enormous velocity in the case of Arcturus of two hundred miles per second. One traveling at the rate of this star could circumnavigate our earth in two minutes. These motions of the stars are called proper motions and it is with these motions that the scientific work of the Cincinnati Observatory is largely concerned. Whatever a star's direction of motion, its velocity may be resolved into two others, one acting in a line drawn from the observer to the star, the other at right angles to this line. It is upon this latter component of motion that we are working. We are concerned with the actual change of the star's position upon the celestial sphere.

The ultimate problem of astronomy is the structure of the universe and no branch of the science offers more in the solution of this great problem than a knowledge of the motions of the stars. The stars are at such infinite distances that, although their actual velocities are very great, their apparent motions on the celestial sphere are small and very careful and accurate observations are required to detect them.

More than half the work done by astronomers of the past two hundred years has been that of making exceedingly accurate observations of the positions of the stars upon the celestial sphere. These positions are published in volumes known as star catalogues, and we probably have in the catalogues of our library the accurate positions of more than one hundred thousand stars.

If we wish to determine the proper motion of a star whose position was accurately observed at some preceding date we observe its present position with our meridian circle. Finding that the star occupies a different position than it did at the time of its earlier observation, we say that it has a proper motion for the interval of time between the

dates or epochs of observation equal to the distance between the two positions. Knowing the star's proper motion and the direction it is moving, we are able to tell what position it will occupy on the celestial sphere in the future. This, of course, is true of all the stars of the catalogues and, if the proper motions of the one hundred thousand stars contained in them were accurately known, they would constitute data of inestimable value to the science.

These star catalogues are an asset of ever increasing value to astronomy, for with a longer interval of time between the dates of observation we have a correspondingly greater change in the star's position and hence a more accurate determination of proper motion.

The observatory staff is at present engaged in the work of determining the proper motions and accurate positions of some six thousand stars and we trust that when the results are published they will constitute a real and valuable contribution to the study of stellar motions.

The determination of time from the observations of stars as they cross the meridian is a necessity of meridian circle work and a clock running with the utmost precision is required. The Riefler clock which we have possesses some unique and interesting features. It is wound by an electric battery and is enclosed in an air-tight glass case from which the air may be exhausted by a hand pump. The clock work may thus be kept under a condition of constant pressure, if desired, or changed at will to increase or decrease the clock rate. The case was sealed up more than two years ago and has not since been touched.

An astronomical clock is not necessarily set to give the correct time exactly. A time observation consists in determining the correction which must be added to the clock reading at any instant to make it correct and that is determined to the one hundredth part of a second from our observations. So accurately does this clock run that if, we were to make no observations for the next year, it is probable that we could rely on it for that period to give us the correct time to within a very few seconds. Its correction to-day differs but three seconds from its correction one year ago. Our mean time clock is regulated from day to day and its dial always gives the correct Cincinnati mean time. It is from this clock that we give traction companies, clockmakers and others the correct time.

During the last few years the poles of the earth have been points of no little popular interest. But now that our explorers have actually discovered them there seems to be little more that may be said about them. One of the most interesting facts, however, concerning the poles seems to have been overlooked by our explorers, namely—they do not occupy the same points on the earth's surface continuously but are

traveling about in a spiral curve in the cold and barren regions which they occupy. When this fact becomes more generally known may we not expect some adventurous explorer to pitch his camp within the spiral some fine morning of the long arctic day and watch the pole go round.

Putting the matter in more specific language, we say that the axis about which the earth rotates is continuously changing. The plane of the equator, dividing the earth into the northern and southern hemispheres, is always perpendicular to the earth's axis. If the axis shifts the plane shifts and the line which is put down on our maps as the equator really moves north and south upon the earth's surface. The latitude of a place measured from this moving equator will appear to change. In fact it actually does change and this peculiar phenomenon is known to astronomers by the technical name of "Variation of Latitude."

This was first brought to light by an astronomer who was combining and discussing the data contained in a number of star catalogues. So important did it appear to be that its observation was undertaken as an international problem. Observing stations were established on the earth's surface at such points as should render their observations most effective in determining the amount and direction of this shift. You will appreciate how widely they are distributed, when I say that they may be found in South America, South Africa, Japan, Russia, Europe, and of the three in this country one is located at the Cincinnati Observatory.

Accurate observations of latitude are made here throughout the year with an instrument especially adapted to the purpose. The results are forwarded to the International Latitude Bureau in Germany, where they are combined with those from all the other stations to determine the path of the pole. So accurately is the problem worked out that the position of the pole is known to within two or three feet.

The last publication of the Cincinnati Observatory was a volume of observations made with the sixteen-inch telescope, giving the accurate positions of nebulae. The instrument has also been used to observe comets and asteroids and these results are published in the current astronomical journals.

There seems to be a popular idea extant that the astronomer's chief business is to sit at the eye-end of a telescope, look with awe and admiration at the craters on the moon, exclaim at the beauties of Saturn and his rings, or sweep the heavens in quest of new objects. Nothing could be farther from the truth. A carefully outlined plan of work, which often requires years to complete, is absolutely necessary if one wishes to make a real contribution to the science. New discoveries are sometimes the by-products of carefully planned work and sometimes unexpected results are obtained. But the great truths which man's intelligence has brought to light have been the results of lifetimes of labor.

THE REVISED DRAPER CATALOGUE.

ANNIE J. CANNON.

In former times the astronomer devoted himself mainly to the solar system. But recently the great problem of the structure and constitution of the sidereal universe has engaged the mind of man. With the investigations of the brightness, the distances and the motions of the stars, there has arisen within the last two or three years, a widespread interest in the classification of stars by means of their spectra. So long as the spectrum of a star was an isolated fact, unconnected with any other property, the classification seemed rather as a pleasant occupation, than one of far reaching importance. But now that the spectral type has been found to be closely connected with the variability of stars, with their parallax and proper motions, with the velocities with which they are moving in space, and with the periods and orbits of binary systems, it seems somewhat as if the magic key has been found which will unlock many of the long-hidden mysteries of the universe. The presence of bright hydrogen lines in the banded spectra was recognized twenty years ago at Harvard as being an index to a star's variability, and 175 variable stars have been discovered in that way. Recent investigations have shown the remarkable fact that stellar motions are functions of the class of spectrum, that stars of the so-called "early" spectral type, as O and B, are traveling slowly, while stars of "later" type, such as class M, are traveling much more rapidly. So universal is the recognition of the importance of a knowledge of the spectra of the stars, that the directors of the several Nautical Almanacs at a conference held in Paris in October, 1911, decided that the names of stars shall be accompanied by their spectral type according to the Draper notation.

The photography of stellar spectra was undertaken in 1885 by Professor Edward C. Pickering, the present director of the Harvard Observatory, and the work was greatly aided in 1886 by Mrs. Draper, who established the Henry Draper Memorial for this great research. The spectra of all stars brighter than the fifth magnitude, and of all stars south of —30°, brighter than the sixth, have already been discussed in detail in the *Annals*. The present catalogue is designed to give the spectra of a large number of stars distributed over the entire sky. The plan includes the observation of all stars whose spectra can be studied upon photographs taken by means of a prism of small angle placed before the object glass of the 8-inch telescopes at Cambridge and Arequipa. The length of exposure is generally 60^m. On some of the

plates stars of the ninth Durchmusterung magnitude can be classified, but owing to differences of quality and density, the limiting magnitude will vary. It is hoped to include all stars of the eighth magnitude, except perhaps some of those in close clusters. For the purpose of selecting the plates to cover the whole sky, eighty blank charts are used for a "working list". These resemble the Durchmusterung charts, in being ruled with lines of right ascension and declination, but have no star images on them. The number of the best plate covering any region is written on the chart at the position corresponding to the center of the plate, and when the plate is classified, the portion thus covered is ruled off on the chart with diagonal lines. In some portions of the sky the plates overlap, so that it is only necessary to use the central part. Regions not yet satisfactorily covered are being photographed again.

All the observations are made by the writer, and one hour or less is required for the classification of two hundred stars. The plate is placed glass side up on a frame inclined 45°, so that the light of the sky is reflected through the plate by means of a horizontal mirror. Each spectrum is examined with a 2-inch eye-piece or, if faint, a higher power is substituted. The observer numbers each spectrum with ink on the glass side of the plate, and reads off to a recorder the number, an estimate of the intensity of the spectrum on a scale of 10, the class of spectrum, and remarks, if any are needed. The letters P, O, B, A, F, G, K, M and N are used to represent various observed types of spectra. The fact that these letters are out of order and not consecutive is a puzzle to some people, while regarded variously by astronomers as an advantage or a fault of the system. When the letters were selected in 1890 the true order of stellar spectra was not known, and intermediate spectra, like Oe 5, had not been observed. The element helium, which is conspicuous in the B stars, was not even discovered. The letters C, D, E, H, I and L were at first used for supposed subdivisions, but they were dropped later because the appearances they stood for were found to be photographic rather than real. In general, then, P represents the spectra of the gaseous nebulae; O, the spectra consisting mainly of bright lines, such as γ Velorum; B, spectra of the helium type, such as Rigel; A, spectra in which hydrogen predominates, such as Sirius; F, those which are intermediate between the hydrogen and the solar type, as Canopus; G, those of the solar type, such as Capella; K, spectra intermediate between the solar and the banded type, such as Arcturus; M, the banded spectra, such as Betelgeux; and N, the spectra of red stars, such as 19 Piscium, and several variable stars. Since, in general, these letters appear to represent spectra which form a sequence, those coming between two types are designated by numerals following the first letter. Thus, a star between B and A, but nearer B is called B 3 A, or simply B3.

It was found in January 1912, that 5000 stars could be classified each month. That rate of work has been maintained, so that 50,024 were classified by October 1, 1912. Detailed study of the spectra of about 4000 of the brighter stars has given the observer a vivid mental picture of each class of spectrum, so that the relative positions of the lines and peculiar intensities are easily recognized. The laborious work of identification has been aided by the generosity of a member of the Board of Visitors, who has placed two extra assistants at our disposal. The excellent Bonn charts are used for identifying stars between $+90°$ and $-23°$, but the work is much more difficult on the Cordoba charts, owing, perhaps, to the large number of stars on them. The recent publication by Ristenpart of the first section of the charts for the Cape Durchmusterung stars has greatly facilitated the labor of identifying the stars south of $-51°$, and an early completion of this work is earnestly to be desired. When a reduction of the Durchmusterung positions to the epoch 1900 is made, the facts to be used in the catalogue concerning each star are written on cards. About forty thousand of these cards are now arranged in a Library Bureau case in the order of right ascension. They may thus be consulted for any purpose. The spectra of several thousand have already been copied off for astronomers who are investigating such questions as absorption of light in space, or the proper motions and parallax of the stars.

Besides the class of spectrum, it is proposed to give the photometric and photographic magnitudes of the stars in this catalogue, whose number will probably exceed one hundred thousand.

It will thus furnish a large amount of material for studying the distribution of the stars, as regards their brightness, their color, and their stage of development, and may help to unravel some of the mysteries concerning the great sidereal universe, in comparison with which the sun and our solar system must be regarded as a small and insignificant mass.

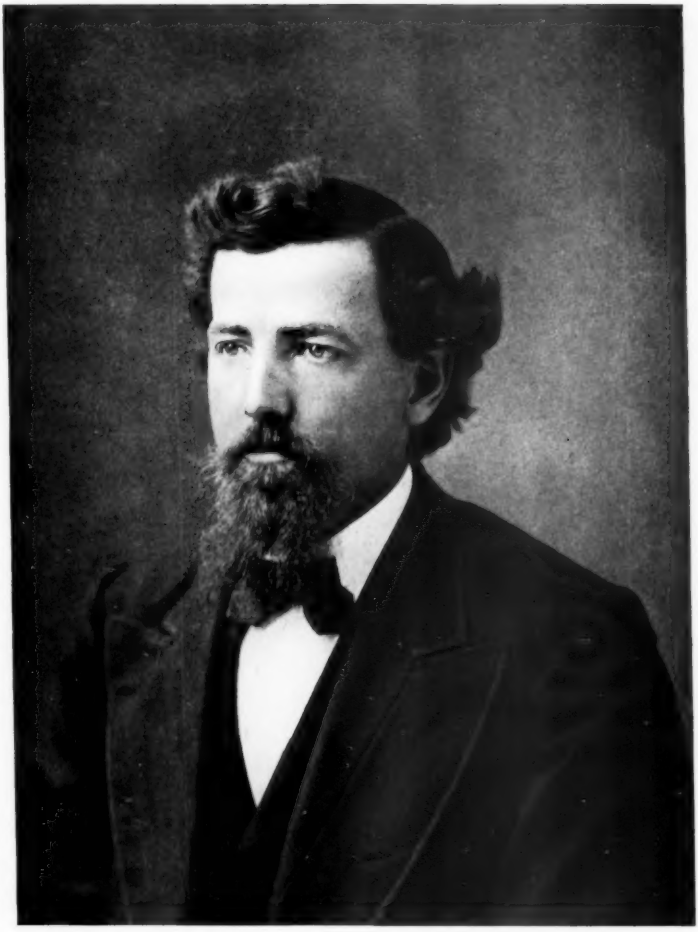
Harvard College Observatory,
Cambridge, Mass. Oct. 17, 1912.

OLIVER CLINTON WENDELL.

EDWARD C. PICKERING.

The death of Oliver Clinton Wendell on November 5, 1912, has deprived Astronomy of one of its most careful observers and enthusiastic devotees. Professor Wendell was born at Dover, N. H., on May 7, 1845. He graduated at Bates College in 1868, and received the degree of Master of Arts in 1871, and of Doctor of Science in 1907. In 1869,

PLATE IV.



OLIVER CLINTON WENDELL

1845–1912

From a photograph taken twenty or thirty years ago.

he served as an assistant to James B. Francis, in the Locks and Canals Corporation of Lowell, Mass., acting in the capacity of civil and hydraulic engineer. He was appointed an assistant in the Harvard College Observatory, in 1879, and became Assistant Professor in 1898, a position he held during the remainder of his life. His first work in Cambridge was with the 15-inch Equatorial and to this instrument he devoted the greater portion of his life. From 1882 to 1888, however, he took part in the observations and reductions of the work of the 4-inch Meridian Photometer. The results will be found in volumes 23 and 24 of the Annals of the Observatory. In earlier years, he made only a portion of the observations with the 15-inch telescope, but after 1893 almost all of those obtained with this instrument were made by him. His earlier observations, which relate to a variety of subjects, are described in Volumes 11, 13, and 33 of the Annals. With a polarizing photometer, he observed a large part of the eclipses of the Satellites of Jupiter, from 1879 to 1903, and all of those taken after that date. In the entire series 910 eclipses were observed. Those preceding 1903 are described in Volume 52 of the Annals. This work was very laborious and fatiguing. The eclipses occur in all parts of the night, and he watched for them with the greatest care on partially cloudy evenings. He would often come to the observatory during a cold winter night, even when there was but little chance of securing an observation. In fact, this characterized all of his observations, as the instruments were so constructed that errors due to passing clouds were completely eliminated. The actual observation of an eclipse of a satellite occupied but a few minutes, but during this time the greatest activity was required. The loss of a few seconds would render the results of but little value. His principal work, however, was with the photometer having achromatic prisms, attached to the 15-inch equatorial. His observations from 1892 to 1902 are contained in part I of Volume 69. They relate mainly to variable stars and are probably more precise than any other similar observations. His later results for the Eclipses of Jupiter's Satellites and for variable stars, which were continued until within a few days of his death, are still unpublished. Active steps are being taked for their complete reduction and it is expected that they will be published in the course of the next few months. In connection with his work he discovered the variability in light of several asteroids and stars.

Although his daily work was of a kind requiring accurate mathematical methods, yet he possessed a poetic temperament and wrote a number of poems. He married Sarah Butler of Hanover, Mass., in 1870, and after her death in 1910, his devotion to her memory undermined his health so that his last two years were sad and unhappy.

OBSERVATIONS OF NOVA GEMINORUM MADE AT MT. WILSON SOLAR OBSERVATORY.

JENNIE B. LASBY.

A series of observations on the spectrum of Nova Geminorum was begun at Mount Wilson on the 22nd of March and continued until May 27. Later two more plates were obtained when the Nova became visible in the eastern sky, these being taken on August 18 and September 4. In all sixteen spectrograms were obtained by Mr. Adams and Mr. Kohlschutter. All of these plates were taken at the 80-foot focus of the 60-inch reflector with the Cassegrain spectrograph. For the first six plates, covering the period from March 22 to April 3, a single prism of 63° angle with a camera lens of 102cm. focal length was used, but the later ones were taken with a lens of 46cm. focal length. Thirteen of these spectrograms cover the region Hϵ to λ 5000 and two were taken of the less refrangible part of the spectrum from Hβ to Hα while the last plate taken September 4 includes the entire spectrum from λ 4000 to Hα.

The first point to be considered is that of the general character of the spectra. The plate taken March 22 showed a continuous spectrum with many dark lines. These lines varied greatly, some being sharp and narrow and others being wide and diffuse. Several faint bands were visible, the more prominent of these being due to parhelium. The hydrogen lines were present as strong bright bands, several Ångstroms wide with double absorption lines to the violet. The spectrograms taken on March 23 and 24 show the dark hydrogen lines still strong and double, but there was a marked decrease in the intensity of the continuous spectrum and rapid changes in the absorption lines, many of which disappear.

One of the most noticeable changes takes place in the two chief maxima of intensity at the edge of the bright hydrogen bands. On the earlier spectrograms they appear nearly equal, but on the plate taken March 30 the violet maximum is broader and slightly stronger, while the spectrogram taken April 3 shows the red component to be much more prominent; and this continues to be the case until the end of the series of observations. The measures of the bright hydrogen bands show that the centers are displaced to the red, which is also the case of Nova Persei, and the displacement seems to be directly proportional to the square of the wave-length. The dark hydrogen lines were only measured upon a few of the plates, as the character of the lines made the measures very uncertain, but the values obtained are better satisfied by a law in which the displacement is proportional to the first power of the wave-length.

The later plates of the series show a steady decrease in the intensity of the continuous spectrum and an increase of the bright bands in the spectrum, many of which are characteristic of the spectrum of the nebulæ. The spectrogram taken on April 6 shows the chief nebular line at λ 5007, and from that time it shows a rapid increase of intensity until, on May 27, it is nearly as strong as Hβ. The nebular line λ 4959 was not seen until April 22 but, as in the case of λ 5007, it grows rapidly stronger. The two plates taken after an interval of about three months indicate the further development toward the nebular stage. The line λ 5007 is much stronger than Hβ and λ 4365 exceeds Hλ in intensity. The nebular lines λ 4959 and λ 5757 have also become conspicuous.

The region between λ 4600 and λ 4700 shows many changes. The first photographs show a trace of bright bands, but on March 30 a strong double bright band is present, which extends from λ 4628 to λ 4670 with the centers of its components at λ 4648 and λ 4662. This reaches its maximum about April 28, when it covers the region from λ 4574 to λ 4681. Still later plates show this band to be broken up into several components, the center of the brightest of these being at λ 4642, and on the spectrograms taken in May its intensity is nearly equal to that of Hβ. The photographs of August and September show that this band has become faint.

One of the important features of the investigation of Nova Geminorum is the identification of the fine lines as well as the bands. The sodium lines D_1 and D_2 are present and are seen as narrow absorption lines in a bright band whose red edge falls at λ 5910. The *b* group of magnesium is probably present as a faint bright band extending from λ 5160 to λ 5184. The magnesium line λ 4481 is probably to be identified with a maximum in the band λ 4463-4485. A number of faint absorption lines may be identified with those of iron and titanium and a number of enhanced lines of these elements seem to be present. Some of the faint lines measured seem to be coincident with the lines of calcium but the large number of dark lines renders the identification somewhat uncertain. A bright band extends from λ 4224 to λ 4246, with a center about λ 4235, but this seems to be too far to the red to be identified with λ 4227. The H and K lines are present on the earliest plates as narrow absorption lines in broad bright bands.

After the announcement was made by Professor Küstner and Dr. Giebeler of the presence of dark lines in the spectrum of the Nova, which were due to radium and radium emanation, an effort was made to identify some of these. Unfortunately the first observations made at this observatory were several days later than the first observations at Bonn. Of the twelve lines in the Nova found by Giebeler to correspond to the lines in the spark spectrum of radium, seven were measured

upon Mt. Wilson plates. Two of those fall in the H band and in a a group of dark lines so numerous that the probability of accidental coincidence is great. The measures on two of the remaining five lines show a good agreement with those of Giebeler, but the identification seems uncertain, since the results show a discrepancy of over an Ångstrom unit from the radium lines. There seemed to be nothing in the Nova to correspond to some of the brighter radium lines.

There seems to be the same lack of positive evidence of the existence of the lines due to radium emanation, about fifty per cent of the lines of that spectrum having possible coincidence in the Nova spectrum.

As indicated in the preceding paragraphs, several lines were present which could be used for the determination of the radial velocity. These lines included the narrow absorption lines H and K of calcium, a few faint lines mostly due to iron, and the lines D_1 and D_2 which appear upon one of the plates of the less refrangible region.

The following table shows the values obtained from the total number of available lines.

Plate	Lines	Radial Velocity
λ 1076	H	+ 10.9
1083	H-K	+ 17.3
1087	H-K	+ 3.8
1104	H	+ 5.6
1118	H	+ 1.0
1189	D_1 D_2	+ 17.9
1176	4222-4528	+ 18.0
1183	4222-4236-4528	+ 10.2
1187	4222-4250-4494-4501-4528	+ 5.9

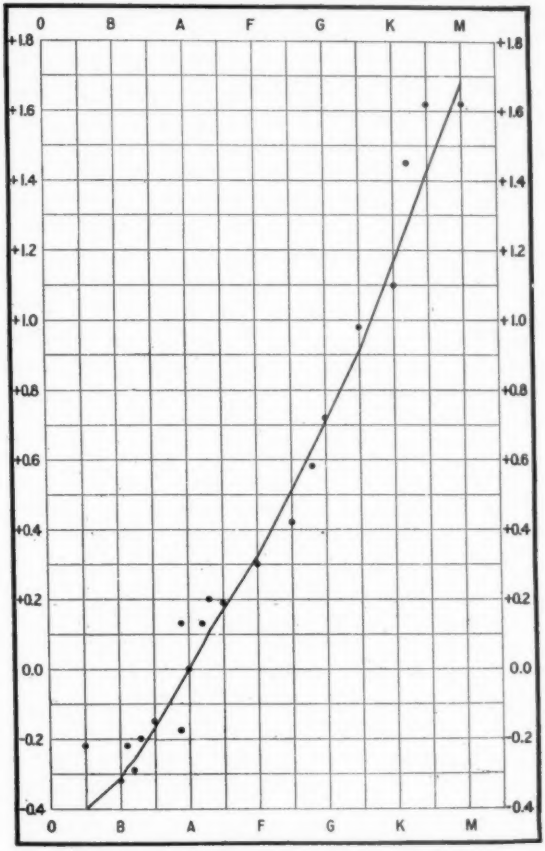
The mean of the results gives as the radial velocity of Nova Geminorum +10 km., and, while the range is large, the small number of lines used and their character makes it improbable that this indicates a real variation of velocity.

ABSORPTION OF LIGHT IN SPACE.

EDWARD S. KING.

Space as well as time appears to be illimitable and eternal. Astronomical research simply pushes the boundaries of human knowledge a little further into what was previously unknown. One of the interesting problems relating to space is whether the light from the stars suffers any diminution in traversing the immense distances before reaching our atmosphere.

The data on which my work has been based consisted in a series of photographic magnitudes of the brighter stars, accurately determined, as fully described in the *Harvard Annals*, Vol. 59, or briefly described in Popular Astronomy, Vol. 20, page 505. I found by comparing these magnitudes with the visual magnitudes from the Revised Harvard Pho-



Photographic Magnitude Minus Visual Magnitude.

tometry, that the differences, when plotted according to the class of spectrum, fell on a curve which was almost a straight line. This is shown in the accompanying figure. The values represent the individual cases so well that we may obtain photographic magnitudes with little error by simply adding them to the magnitudes found visually.

On an average, stars of class B are 0.32 magnitudes brighter, while stars of class M are 1.62 magnitudes fainter photographically than visually. This indicates that stars of class M are redder than those of class B. Thus it is seen that the stars, when arranged, as they are, according to the class of spectrum, have varying degrees of redness. Now the principal part of this redness is due to causes inherent in the star, but a portion may be due to differences in distance. If space is not an absolute void but is filled with dust or fine meteoric matter, such matter must scatter the light. As the blue rays would suffer more than the red rays, the effect would tend to make the more distant stars appear redder. It is therefore assumed that greater redness corresponds to greater distance. If, from the differences between the photographic and visual magnitudes, we subtract the average difference for the class of spectrum, this deviation from the average will represent the degree of redness due to other than inherent causes.

The first step was to gronp the deviations for the several stars according to the parallaxes. The result showed that the stars having smaller parallax, and consequently having the greater distance were redder. As the next step, all stars having a parallax of 0″.030 or smaller were rejected from our list. This left 26 stars. Following Kapteyn's work in No. 42 of the Contributions from the Mount Wilson Solar Observatory, the difference between the photographic and the visual magnitude may be considered as the sum of four quantities:—(1) the inherent redness of the star as indicated by the average difference for the class of spectrum, (2) the redness dependent on the apparent magnitude, (3) the redness dependent on the absolute magnitude, and (4) the redness dependent on distance. The unit of distance for computation was taken for the value of parallax equal to 0″.1, or the distance measured by 32.6 light-years. To eliminate (2), a grouping of the deviations was made according to magnitude. As the result, the fainter stars, which are probably more distant, appeared very slightly redder. The other two factors were reduced by the method of least squares. The result indicated a loss of 0.0377 magnitudes for the photographic rays, and 0.0184 magnitudes for the visual rays, while traversing the unit of distance.

These figures having been derived from 26 stars, it was thought best to improve the data by applying the method to other stars. Accordingly, a supplementary list of 22 stars was observed. The procedure was in all respects that followed previously. The resulting values had the same sign, indicating absorption by greater redness of the more distant stars, but were somewhat larger than before.

If all the stars were of the same class of spectrum, the problem would be much easier. In examining the 48 stars thus far measured, the

several classes of spectrum were found to have from 4 to 8 stars each. A separate reduction was made from each of these classes, which in all cases showed greater redness corresponding to greater distance.

Another improvement in the data was effected by selecting from both lists only those stars having the parallax most accurately determined. This reduced the number of stars to 28. The reduction of these gave values identical with the results found previously from the 26 stars. Thus, the indications from this work all point to the presence of an absorbing medium in space, or some factor which produces effects similar to absorption, by making the more distant stars appear redder.

ASTRONOMICAL PHENOMENA IN 1913.

ECLIPSES.

In the year 1913 there will be five eclipses, three of the sun and two of the moon. Those of the moon will both be total while those of the sun will all be partial eclipses. The following data concerning them are taken from the *American Ephemeris* for 1913.

I.—*A Total Eclipse of the Moon*, 1913, March 21-22, partly visible at Washington, the moon setting eclipsed; the beginning visible generally in North America, western South America, throughout the Pacific Ocean, Australia, and the eastern border of Asia; the ending visible generally in western North America, the Pacific Ocean, Australia, central and eastern Asia.

ELEMENTS OF THE ECLIPSE.

Greenwich mean time of opposition in right ascension, March $21^d\ 23^h\ 47^m\ 57^s.7$

	h	m	s			s
Sun's right ascension	0	4	37.49	Hourly motion		9.10
Moon's right ascension	12	4	37.49	Hourly motion		132.19
	°	′	″		′	″
Sun's declination	0	30	5.7 N.	Hourly motion	0	59.2 N.
Moon's declination	0	18	26.1 S.	Hourly motion	18	7.3 S.
Sun's equa. hor. parallax			8.8	Sun's true semidiameter	16	2.8
Moon's equa. hor. parallax		60	58.9	Moon's true semidiameter	16	36.2

CIRCUMSTANCES OF THE ECLIPSE.

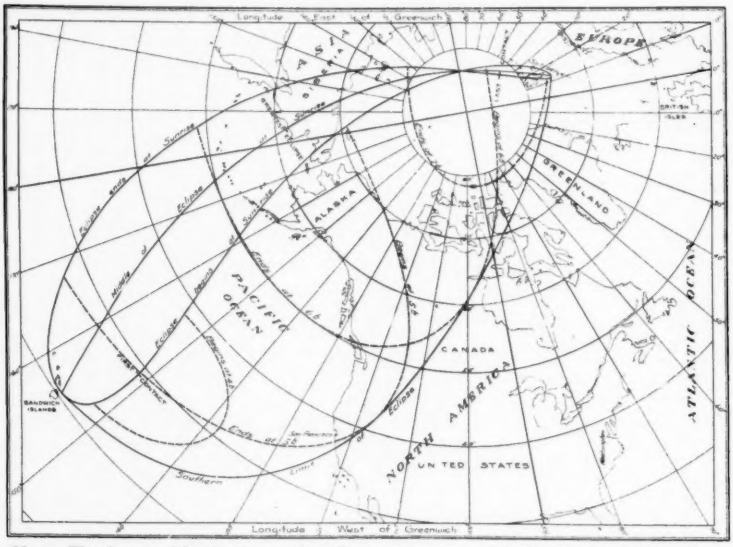
	d	h	m	
Moon enters penumbra	March 21	21	16.3	Greenwich Mean Time.
Moon enters shadow	21	22	12.6	
Total eclipse begins	21	23	10.9	
Middle of the eclipse	21	23	57.6	
Total eclipse ends	22	0	44.4	
Moon leaves shadow	22	1	42.6	
Moon leaves penumbra	22	2	38.9	

Contacts of Shadow with Moon's limb.	Angles of position from the north point.	The Moon being in the zenith in longitude from Greenwich.	and in latitude.
	°	° ′	° ′
First	128 to E.	152 11 W.	0 10 N.
Last	70 to W.	157 6 E.	0 53 S.

Magnitude of the eclipse = 1.575 (Moon's diameter = 1.0).

II.—*A Partial Eclipse of the Sun*, 1913, April 6, invisible at Washington.

PARTIAL ECLIPSE OF THE SUN APRIL 6, 1913.



Note:–The hours of beginning and ending are expressed in Greenwich Mean Time.

ELEMENTS OF THE ECLIPSE.

					d	h	m	s
Greenwich mean time of conjunction in right ascension.				April	6	6	54	57.9
	h	m	s		s		s	
Sun and Moon's R. A.	1	0	18.70	Hourly motion	9.14	and	109.32	
	°	′	″		′		″	
Sun's declination	6	26	20.3 N.	Hourly motion	0		56.7 N.	
Moon's declination	7	47	54.8 N.	Hourly motion	14		14.0 N.	
Sun's equa. hor. parallax			8.8	Sun's true semidiameter	15		58.5	
Moon's equa. hor. parallax		54	51.4	Moon's true semidiameter	14		56.2	

CIRCUMSTANCES OF THE ECLIPSE.

	Greenwich Mean Time.				Longitude from Greenwich.			Latitude.		
	d	h	m		°	′		°	′	
Eclipse begins	April	6	3	53.9	151	24.1	W.	28	59.0	N.
Greatest eclipse		6	5	32.9	175	32.3	E.	61	20.5	N.
Eclipse ends		6	7	11.2	37	49.1	E.	82	9.3	N.

Magnitude of greatest eclipse = 0.424 (Sun's diameter = 1.0).

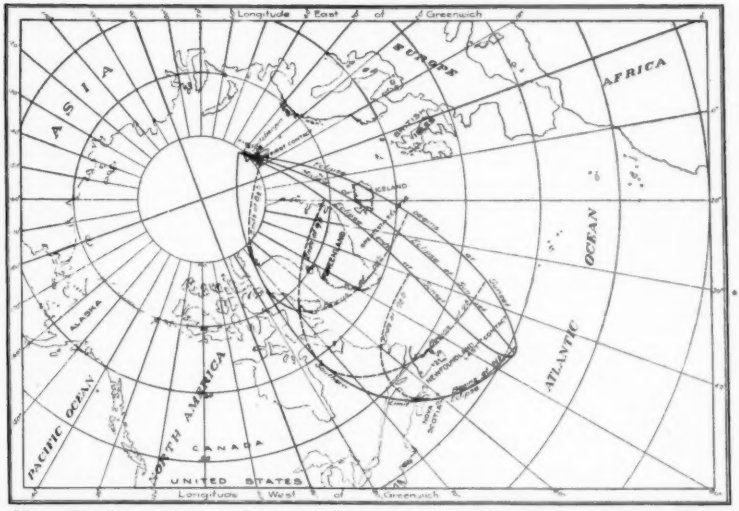
III.—*A Partial Eclipse of the Sun*, 1913, August 31, invisible at Washington.

ELEMENTS OF THE ECLIPSE.

Greenwich mean time of conjunction in right ascension, August 31^d 7^h 34^m 56^s.7

	h	m	s		s		s
Sun and Moon's R. A.	10	37	45.36	Hourly motion	9.09	and	137.98
	°	′	″		′	″	
Sun's declination	8	39	48.0 N.	Hourly motion	0	54.1	S.
Moon's declination	10	19	39.3 N.	Hourly motion	17	14.2	S.
Sun's equa. hor. parallax			8.7	Sun's true semidiameter	15	51.0	
Moon's equa. hor. parallax		61	17.3	Moon's true semidiameter	16	41.2	

PARTIAL ECLIPSE OF THE SUN AUGUST 31, 1913.



Note:–The hours of beginning and ending are expressed in Greenwich Mean Time.

CIRCUMSTANCES OF THE ECLIPSE.

	Greenwich Mean Time.				Longitude from Greenwich.			Latitude.		
	d	h	m		°	′		°	′	
Eclipse begins	August 31	8	2.5		13	16.0	E.	77	36.3	N.
Greatest eclipse	31	8	52.0		26	36.2	W.	61	36.5	N.
Eclipse ends	31	9	42.0		47	5.0	W.	43	44.5	N.

Magnitude of greatest eclipse = 0.151 (Sun's diameter = 1.0).

IV.—*A Total Eclipse of the Moon*, 1913, September 14–15, the moon setting at Washington as the eclipse begins; the beginning visible generally in North America excepting the extreme northern portions, the Pacific Ocean, Australia, and eastern Asia; the ending visible generally in Alaska, the Pacific Ocean excepting the eastern portions, Australia, and Asia.

ELEMENTS OF THE ECLIPSE.

Greenwich mean time of opposition in right ascension, Sept. $15^d\ 0^h\ 34^m\ 9^s.4$

	h	m	s				
Sun's right ascension	11	30	47.50	Hourly motion			8.97
Moon's right ascension	23	30	47.50	Hourly motion			104.22
	°	′	″			′	″
Sun's declination	3	9	22.0 N.	Hourly motion		0	57.7 S.
Moon's declination	3	22	23.2 S.	Hourly motion		14	8.8 N.
Sun's equa. hor. parallax			8.8	Sun's true semidiameter		15	54.6
Moon's equa. hor. parallax		53	58.2	Moon's true semidiameter		14	41.7

CIRCUMSTANCES OF THE ECLIPSE.

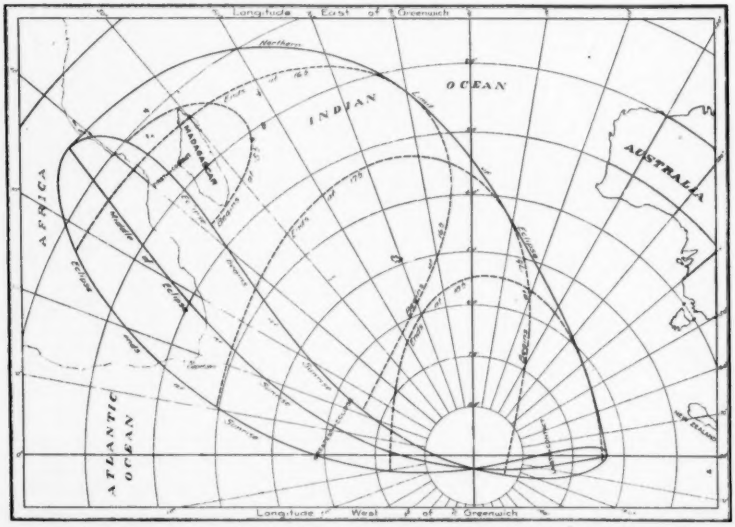
	d	h	m	
Moon enters penumbra	September 14	21	39.9	Greenwich Mean Time.
Moon enters shadow	14	22	52.5	
Total eclipse begins	15	0	1.0	
Middle of the eclipse	15	0	48.1	
Total eclipse ends	15	1	35.2	
Moon leaves shadow	15	2	43.6	
Moon leaves penumbra	15	3	56.3	

Contacts of Shadow with Moon's limb.	Angles of position from the north point.	The Moon being in the zenith in longitude from Greenwich.	and in latitude.
	°	° ′	° ′
First	49 to E.	164 58 W.	3 46 S.
Last	107 to W.	138 46 E.	2 52 S.

Magnitude of the eclipse = 1.435 (Moon's diameter = 1.0).

V.—*A Partial Eclipse of the Sun*, 1913, September 29, invisible at Washington.

PARTIAL ECLIPSE OF THE SUN SEPTEMBER 29, 1913.



Note:–The hours of beginning and ending are expressed in Greenwich Mean Time.

ELEMENTS OF THE ECLIPSE.

Greenwich mean time of conjunction in right ascension, Sept. $29^d\ 17^h\ 48^m\ 1^s.8$.

	h	m	s		s		s
Sun and Moon's R. A.	12	23	43.00	Hourly motions	9.04 and		34.16
	°	′	″		′	″	
Sun's declination	2	33	57.9 S.	Hourly motion	0	58.4	S.
Moon's declination	3	50	48.1 S.	Hourly motion	18	9.0	S.
Sun's equa. hor. parallax			8.8	Sun's true semidiameter	15	58.5	
Moon's equa. hor. parallax		61	17.6	Moon's true semidiameter	16	41.3	

CIRCUMSTANCES OF THE ECLIPSE.

	Greenwich Mean Time.			Longitude from Greenwich.		Latitude.	
	d	h	m	°	′	°	′
Eclipse begins September	29	14	55.6	42	54.0 E	17	5.2 S.
Greatest eclipse	29	16	45.6	11	31.2 E	61	12.6 S.
Eclipse ends	29	18	35.2	178	12.4 E	74	41.3 S.

Magnitude of greatest eclipse $=0.825$ (Sun's diameter $=1.0$).

The regions within which the eclipses of the sun are visible are laid down on the accompanying charts, from which, by means of the dotted lines, the Greenwich mean times of beginning and ending at any place may be found with an uncertainty which will vary from three or four minutes for a high sun to fifteen or twenty minutes when the sun is near the horizon.

THE PLANETS.

The charts, Figs. 4 and 5, place before the reader's eye the apparent courses of the seven major planets through the sky during the year.

Mercury starts his course in the southern part of *Ophiuchus*, moves eastward along the ecliptic until the middle of March, then makes a loop in *Pisces* as he passes between the earth and sun at the time of inferior conjunction. From May to July his course is again eastward; in July and August he circles a rather wide loop in *Cancer*, being at inferior conjunction August 3. During the next two months his course is along the descending slope of the ecliptic. In November the retrograde movement produces a large, roughly Z-shaped, loop in *Scorpio* and *Libra*. The finish of his course for the year is in *Ophiuchus*, about seven degrees east of the starting point.

The times of conjunction and greatest elongation of Mercury east and west from the sun are given, in Washington mean time, in the following table:

Superior Conjunction		Greatest Elongation East				Inferior Conjunction		Greatest Elongation West			
	h			h	°	′		h			
Feb. 12	6	Mar 10	14	18	19	Mar. 27	11	Apr. 24	11	27	12
June 1	6	July 6	22	26	13	Aug. 3	18	Aug. 21	19	18	26
Sept. 15	22	Nov. 1	11	23	34	Nov. 22	13	Dec. 10	9	21	02

The planet will be best seen as evening star a few days before March 10, and as morning star a few days after August 21.

Venus does not make the entire circuit of the zodiac during the year, starting her course in the eastern part of *Capricornus* and ending in the western part of *Sagittarius*. Her apparent path is shown by the broken line in Figure 4. Her

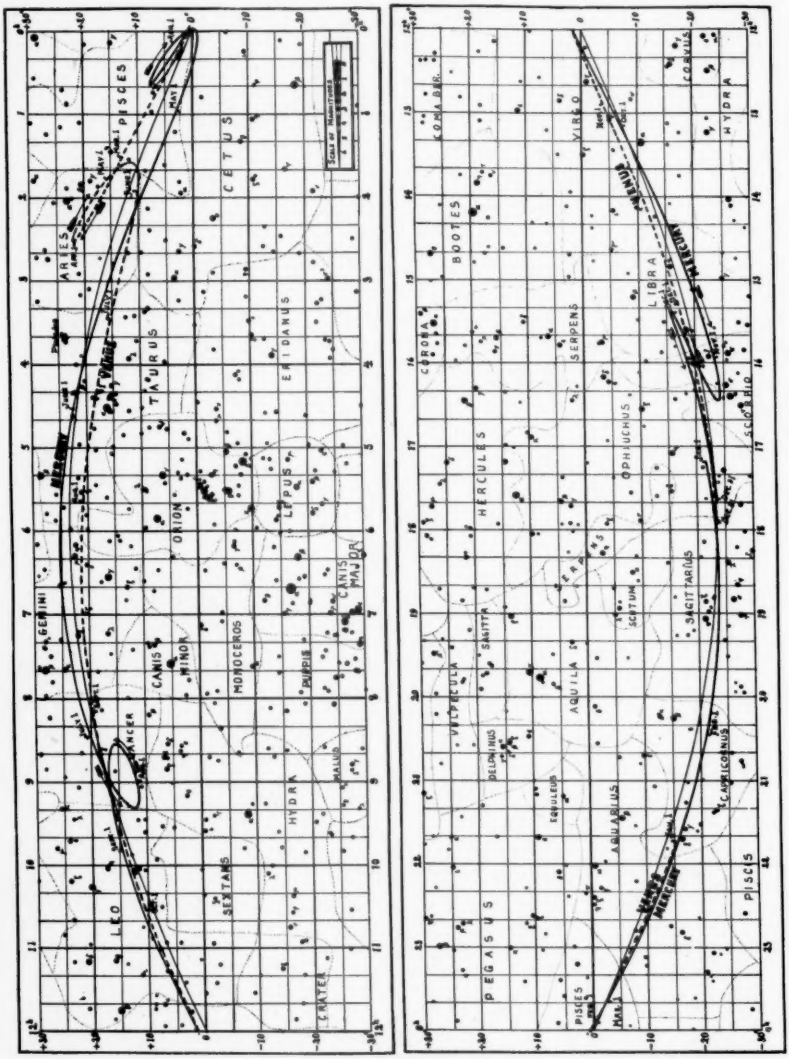


FIG. 4. APPARENT PATHS OF THE PLANETS MERCURY AND VENUS AMONG THE STARS DURING THE YEAR 1913.

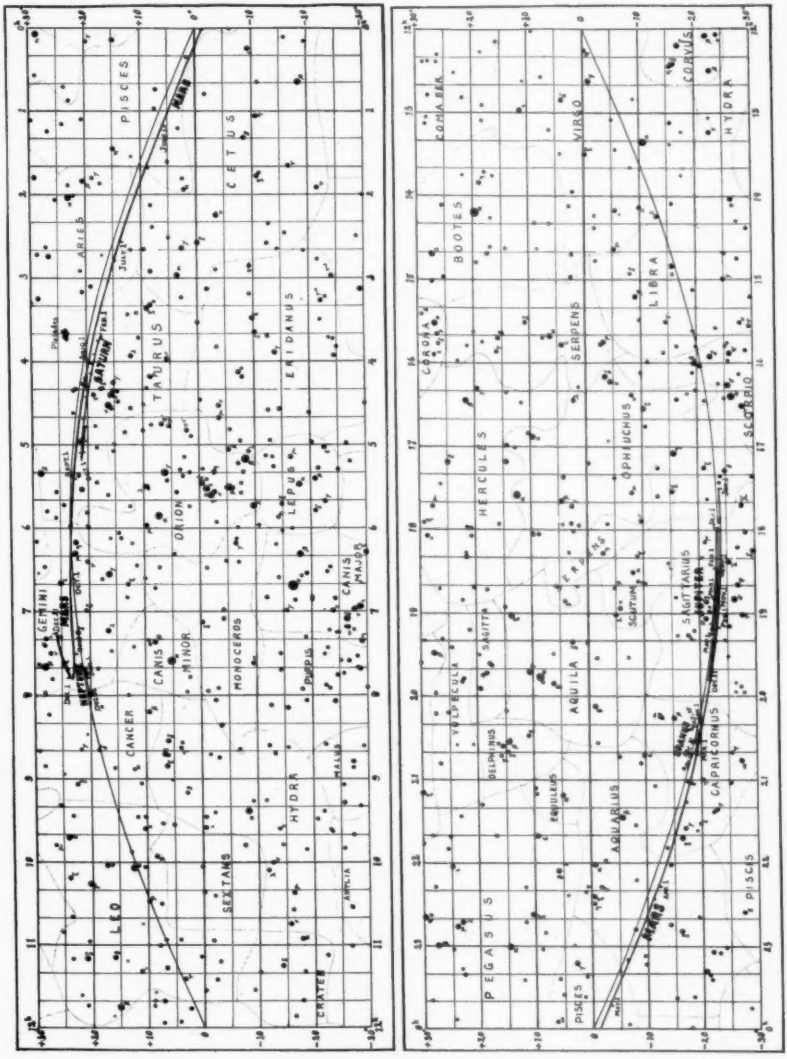


FIG. 5. APPARENT PATHS OF THE PLANETS MARS, JUPITER, SATURN, URANUS AND NEPTUNE AMONG THE STARS DURING THE YEAR 1913.

retrograde movement in April and May, as she passes between the earth and sun, forms a great closed loop in the constellation *Aries*. Inferior conjunction will occur on April 24. Up to that time Venus will be the evening star, appearing as a very brilliant star in the west in the early evening, and after that date the planet will be morning star, seen toward the east before sunrise.

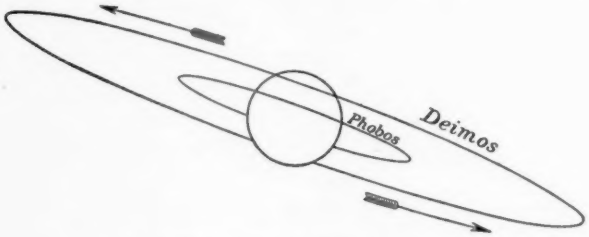


FIG. 6. SATELLITES OF MARS, 1913.
Apparent orbits of the satellites of Mars, at date of opposition, January 5, 1914, as seen in an inverting telescope.

Venus will be at greatest elongation east from the sun, 18° 19′, March 10, and at greatest brilliancy March 18. It will then be of stellar magnitude —4.3, or about twelve times as bright as Sirius. All this winter and into the spring Venus will therefore be a splendid object in the western evening sky. In April she will pass between the earth and sun and on May 30 will reach her greatest brilliancy (stellar magnitude — 4.2) in the morning eastern sky. Greatest western elongation, 45° 44′ from the sun, will occur on July 3.

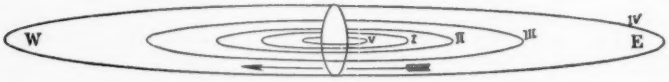


FIG. 7. SATELLITES OF JUPITER, 1913.
Apparent orbits of the satellites of Jupiter at date of opposition, July 4, 1913, as seen in an inverting telescope.

Mars, as indicated in Figure 5, moves eastward from a point in *Ophiuchus* near the beginning of Mercury's course, through *Sagittarius*, *Aquarius*, *Pisces*, *Taurus* and *Gemini*, passing on its way Jupiter, Uranus and Saturn. In the constellation *Gemini*, during the last two months of the year Mars makes the first half of a loop similar to those made by Mercury and Venus. The loop will be completed during January and February of 1914, the planet coming to opposition on January 5 of that year. The opposition of next winter will be one of the less favorable ones for the study of Mars, because its distance from the earth will be relatively great, the nearest approach being about 58,000,000 miles. On the other hand, for several months, before and after opposition the meridian altitude of the planet as seen from the northern hemisphere will be high, so that the conditions of good seeing will largely offset the unfavorable condition of distance.

Figure 6 shows the apparent orbits of the two tiny satellites of Mars. These can be seen only with the aid of a large telescope.

Jupiter, to northern observers, will be unfavorably situated in 1913 because of its low altitude. On the other hand, to southern observers the planet will be most favorably situated. Jupiter's apparent course lies wholly in the constellation *Sagittarius*, the motion being eastward from January to May, westward from May to September and eastward after September 1. The planet will be at opposition July 4. Figure 7 shows the apparent orbits of the five inner satellites of Jupiter as seen in an inverting telescope. Satellite V is visible only with the aid of the great telescopes like the Lick and Yerkes telescopes, but Satellites I, II, III and IV are visible and very interesting to watch with a small telescope. Satellites VI, VII and VIII are not represented on the chart, because they are invisible except with largest telescopes.

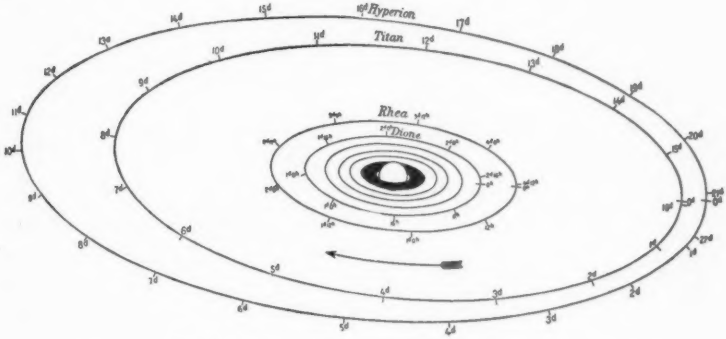


FIG. 8. SATELLITES OF SATURN, 1913.
APPARENT ORBITS OF THE SEVEN INNER SATELLITES OF SATURN, AT DATE OF OPPOSITION, DECEMBER 6, 1913, AS SEEN IN AN INVERTING TELESCOPE.

Saturn's course lies wholly in the constellation *Taurus*. Directly south of the Pleiades in January, the planet moves westward until the end of the month, then eastward until October, then westward again until the end of the year. Saturn is brighter than Aldebaran so that there is never any difficulty about recognizing the planet. This will be a favorable year for northern observers to study Saturn because of the high meridian altitude of the planet.

Figure 8 shows the apparent orbits of the seven inner satellites of Saturn and the general aspect of the rings. Ordinarily one is able with a moderate sized telescope to see three or four of these satellites in the field of view with the planet on any night when the conditions for seeing are good. A small telescope will show the rings as one ring and a moderate sized instrument, with good eyepieces magnifying from 100 to 300 times, will show the separate rings.

Uranus in *Capricornus* moves only about six degrees during the year, eastward until May 15, then westward until October 15, and eastward the rest of the year. The planet is favorably situated for southern, but unfavorably for northern observers, appearing to the latter always at a low altitude. Uranus is visible with a small telescope but no details of its surface can be detected. The satellites, whose apparent orbits are shown in Fig. 9, require the use of a large telescope. Uranus will be at opposition July 28.

Neptune is in *Gemini*, about seven degrees south of Pollux, moving westward until April 3, then eastward until November 1, and westward again until the end of the year. The planet is visible with the aid of a small telescope, but looks so much like a star that one needs a chart showing the faint stars in its vicinity in

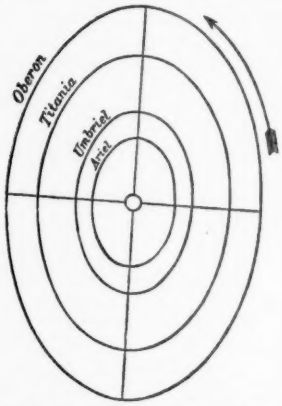


FIG. 9. SATELLITES OF URANUS, 1913. Apparent orbits of the satellites of Uranus at date of opposition, July 28, 1913, as seen in an inverting telescope.

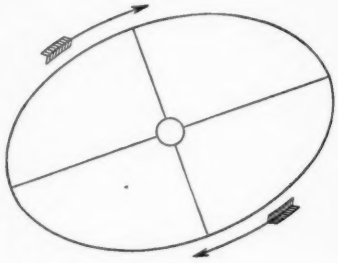


FIG. 10. SATELLITE OF NEPTUNE, 1913. Apparent orbit of the satellite of Neptune at date of opposition January 14, 1913, as seen in an inverting telescope.

order to identify the planet. Its motion is very slow but can be recognized from night to night by comparison with the neighboring stars. Figure 10 shows the apparent orbit of Neptune's one satellite, which can be seen only with the aid of a powerful telescope. Neptune will be at opposition January 14.

COMETS.

The three comets, *a*, *b* and *c* of 1912, will be visible for a short time in 1913, comet *a* remaining in sight with the aid of large telescopes for probably three or four months. Three periodic comets are due at perihelion but none of them are likely to be detected, at least with small telescopes.

1. Holmes' periodic comet is due at perihelion in January but under very unfavorable conditions, the comet being farther away from the earth than the sun at that time. It was exceedingly faint at its return in 1906.

2. Finlay's comet was observed in 1906, but this year at the timeof perihelion it will be almost behind the sun. It is possible that the period may have been considerably changed by the perturbations of Jupiter, near which planet the comet was for a long time, at the time of its aphelion passage in 1909-10.

3. The comet 1894 IV (E. Swift; DeVico?) is due about the first of December, if the period calculated for its return in 1906 has received no further change since that time. This comet has however not been seen since 1894, and even then it was a very faint object, so that the chance of its being found is exceedingly slight.

METEORS.

Meteors may be observed on any clear night, especially when the moon is absent. They may be seen in any part of the sky. They are of all degrees of brightness and each one lasts only a few seconds. Many seem to move in directions at random across the sky; others radiate from certain common points.

Observations are of value which consist in merely counting systematically the meteors which are seen in a given time in a given area of the sky. Still more valuable observations consist in plotting the trails carefully upon a planisphere star map and recording the brightness and the exact times of the beginning and end of the apparition.

The following is a list of the most brilliant meteoric showers which recur from year to year. It is taken from Mr. W. F. Denning's more extended list in the *Companion to the Observatory* for 1912.

Date.	Radiant. α °	Radiant. δ °	Meteors.
Jan. 2-3	230	+53	Swift; long paths.
Apr. 20-22	271	+33	Swift.
May 1-6	338	— 2	Swift; streaks.
July 28	339	—11	Slow; long.
Aug. 10-13	45	+57	Swift; streaks.
Oct. 18-20	92	+15	Swift; streaks.
Nov. 14-16	150	+22	Swift; streaks.
Nov. 17-23	25	+43	Very slow; trains.
Dec. 10-12	108	+33	Swift; short.

The Perseids, with a maximum on August 11, are visible for a considerable period and their radiant-point exhibits a motion to east northeast among the stars, as shown in the following ephemeris:

Date.	Radiant. α °	Radiant. δ °	Date.	Radiant. α °	Radiant. δ °	Date.	Radiant. α °	Radiant. δ °
July 19	18.9	+50.5	July 29	29.3	+53.8	Aug. 8	41.5	+56.5
21	20.8	+51.1	31	31.6	+54.4	10	44.3	+56.9
23	22.8	+51.8	Aug. 2	33.9	+55.0	12	47.1	+57.3
25	24.9	+52.5	4	36.4	+55.5	14	50.0	+57.7
27	27.1	+53.2	6	38.9	+56.0	16	52.9	+58.0

VARIABLE STARS.

As heretofore we shall each month give tables of the minima and maxima of variable stars of short period. We have changed the tables slightly, putting all the minima in one table and all the maxima in the other. No distinction is now made between stars of the Algol type and those of the β Lyrae type. The elements used have been the latest that we could find and the computations have been thoroughly checked, so that we hope that no errors have escaped our attention. We shall be glad to receive at any time, reliable observations of minima and maxima of these stars, and to be informed of any errors that may be noticed in the tables.

The table of "Approximate Magnitudes of Variable Stars" of long period will be prepared as heretofore at Harvard College Observatory, through the courtesy of Professor Pickering.

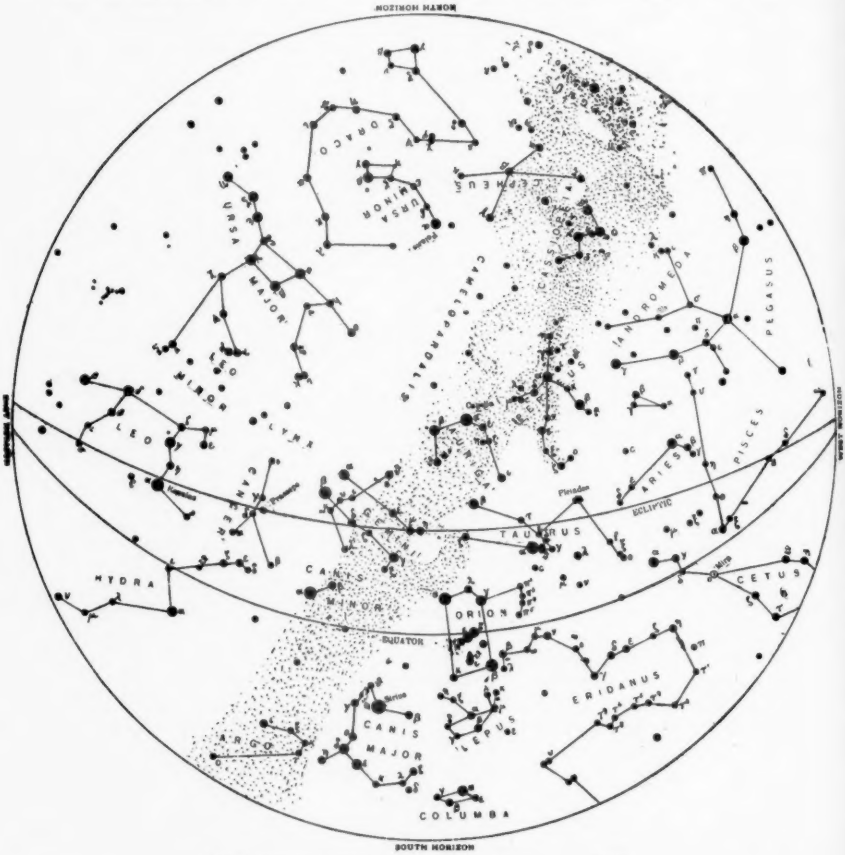
OCCULTATIONS.

A list of 97 occultations of stars by the moon, visible at Washington during this year, is given in the *American Ephemeris* for 1913. We will give the list for each month, a month ahead of time, so that our readers may be on the watch for these interesting phenomena.

The following is the list for February:

Occultations Visible at Washington.

Date 1913	Star's Name	Magnitude	IMMERSION. Washington M.T. h m	Angle from N. °	EMERSION. Washington M.T. h m	Angle from N °	Duration h m
Feb. 11	π Piscium	5.6	8 20	40	9 22	269	1 2
12	27 Arietis	6.4	11 51	86	12 44	244	0 53
15	38 B Aurigae	6.5	5 3	42	6 10	284	1 7
15	47 B Aurigae	6.0	8 17	17	8 51	330	0 34
15	354 B Tauri	6.4	13 34	31	13 59	337	0 25
18	λ Cancri	5.9	5 52	108	6 57	273	1 5
21	89 Leonis	5.7	16 11	118	17 14	314	1 3
22	162 B Virginis	6.2	17 14	205	17 28	228	0 14
23	*g* Virginis	5.6	8 52	129	9 46	294	0 54
25	47 G Librae	6.1	14 54	99	16 7	324	1 13
Feb. 26	48 B Scorpii	4.9	15 44	52	16 20	359	0 26



THE CONSTELLATIONS AT 9:00 P. M. FEBRUARY, 1912.

Saturn's Satellites.

CENTRAL STANDARD TIME.

E = eastern elongation; W = western elongation.
I = inferior conjunction; S = superior conjunction.

I. Mimas. Period $0^d\ 22^h.6$

Feb. 1	h 6.1 W	Feb. 7	h 9.2 E	Feb. 14	h 10.8 W	Feb. 16	h 8.0 W
5	12.0 E	8	7.8 E	15	9.4 W	17	6.7 W
6	10.6 E	9	6.5 E				

II. Enceladus. Period $1^d\ 8^h.9$.

Feb. 1	7.8 E	Feb. 8	4.3 E	Feb. 15	0.7 E	Feb. 21	21.2 E
2	16.7 E	9	13.2 E	16	9.6 E	23	6.1 E
4	1.6 E	10	22.1 E	17	18.5 E	24	15.0 E
5	10.5 E	12	6.9 E	19	3.4 E	25	23.9 E
6	20.3 E	13	15.8 E	20	12.3 E	27	8.8 E
						28	17.7 E

III. Tethys. Period $1^d\ 21^h.3$.

Feb. 1	12.1 E	Feb. 9	1.4 E	Feb. 16	14.7 E	Feb. 24	4.0 E
3	9.5 E	10	22.7 E	18	12.0 E	26	1.3 E
5	6.8 E	12	20.0 E	20	9.3 E	27	22.6 E
7	4.1 E	14	17.4 E	22	6.7 E		

IV. Dione. Period $2^d\ 17^h.7$.

Feb. 1	20.1 E	Feb. 10	1.2 E	Feb. 18	6.3 E	Feb. 23	17.7 E
4	13.8 E	12	18.9 E	21	0.0 E	26	11.5 E
7	7.5 E	15	12.6 E				

V. Rhea. Period $4^d\ 12^h.5$.

Feb. 5	9.1 E	Feb. 14	10.0 E	Feb. 23	11.0 E	Feb. 27	23.5 E
9	21.6 E	18	22.5 E				

VI. Titan. Period $15^d\ 23^h.3$.

Feb. 2	22.2 I	Feb. 10	16.1 S	Feb. 18	21.3 I	Feb. 22	17.6 W
6	18.3 W	14	19.6 E				

VII. Hyperion. Period $21^d\ 7^h.6$

Feb.	1.9 S	Feb.	11.7 I	Feb. 23.2 S	Feb. 28.3 E
	7.0 E		17.2 W		

VIII. Japetus. Period $79^d\ 22^h.1$

Feb. $18^d.8$ I

IX. Phoebe. Period $580^d\ 2^h.9$.

	α Ph.–α Sat.			δ Ph–δ Sat.			α Ph.–α Sat.			δ Ph.–δ Sat.		
	m	s		′	″		m	s		′	″	
Feb. 2	+ 1	45.3		+ 9	35	Feb. 18	1	24.9		8	4	
6	1	40.4		9	14	22	1	19.5		7	40	
10	1	35.4		8	52	26	+1	14.1		7	15	
14	1	30.2		8	28							

VARIABLE STARS.

Approximate Magnitudes of Variable Stars on Dec. 1, 1912.

[Communicated by the Director of Harvard College Observatory, Cambridge, Mass.]

Name.	R. A. 1900. h m	Decl. 1900. ° ′	Magn.	Name.	R.A. 1900. h m	Decl. 1900. ° ′	Magn.
X Androm.	0 10.8	+46 27	13.0	R Cancri	8 11.0	+12 2	10.2
T Androm.	17.2	+26 26	11.0*d*	T Cancri	51.0	+20 14	9.0
T Cassiop.	17.8	+55 14	8.9*d*	Y Draconis	9 31.1	+78 18	8.9*d*
S Ceti	19.0	−95 3	<11.0	R Leonis	42.2	+11 54	9.6 *i*
Y Cephei	31.3	+79 48	<12.0	R Urs.Maj.	10 37.6	+69 18	10.5*d*
U Cassiop.	40.8	+47 43	9.5*d*	T Urs.Maj.	12 31.8	+60 2	8.5*d*
RW Androm.	41.9	+32 8	12.5	RS Urs. Maj.	34.4	+59 2	<12.0
RV Cassiop.	47.1	+46 53	11.6*i*	S Urs. Maj.	39.6	+61 38	8.6 *i*
W Cassiop.	49.0	+58 1	10.9 *i*	S Virginis	13 27.8	− 6 41	7.1
U Androm.	1 9.8	+40 11	13.0	T Urs. Min.	32.6	+73 56	13.0
– Androm.	10.4	+41 12	10.7*d*	U Urs. Min.	14 15.1	+67 15	11.9
S Piscium	12.4	+ 8 24	12.0*d*	S Bootis	19.5	+54 16	10.5
S Cassiop.	12.3	+72 5	13.2	V Bootis	25.7	+39 18	7.9
RU Androm.	32.8	+38 10	14.3	R Camelop.	25.1	+84 17	11.2*d*
Y Androm.	33.7	+38 50	12.0	R Bootis	32.8	+27 10	7.7*d*
X Cassiop.	49.8	+58 46	9.5	S Urs. Min.	15 33.4	+78 58	8.5*d*
R Arietis	2 10.4	+24 35	<10.0	R Cor. Bor.	44.4	+28 28	6.2
W Androm.	11.2	+43 50	8.4	W Cor. Bor.	16 11.8	+38 3	12.0*d*
Z Cephei	12.8	+81 13	<13.0	U Herculis	21.4	+19 7	11.0 *i*
o Ceti	14.3	− 3 26	8.7	W Herculis	31.7	+37 32	<12.0
S Persei	15.7	+58 8	9.0	R Draconis	32.4	+66 58	8.1
RR Persei	21.7	+50 49	<14.0	S Herculis	47.4	+15 7	8.2
U Ceti	28.9	−13 35	<10.0	T Draconis	17 54.8	+58 14	<10.0
RR Cephei	29.4	+80 42	11.6	V Draconis	56.3	+54 53	10.8*d*
R Trianguli	31.0	+33 50	11.2*d*	T Herculis	18 5.3	+31 0	7.7
W Persei	43.2	+56 34	9.1	W Draconis	5.4	+65 56	<12.0
U Arietis	3 5.5	+14 25	13.1	X Draconis	6.8	+66 8	10.2
X Ceti	14.3	− 1 26	9.6	W Lyrae	11.5	+36 38	8.1
Y Persei	20.9	+43 50	8.4	SV Draconis	31.2	+49 18	13.7
R Persei	23.7	+35 20	8.7	RY Lyrae	41.2	+34 34	<13.0
R Tauri	4 22.8	+ 9 56	8.4	Z Lyrae	56.0	+34 49	<12.0
W Tauri	22.2	+15 49	12.1	V Lyrae	19 5.2	+29 30	<13.0
S Tauri	23.7	+ 9 44	<13.0	S Lyrae	9.1	+25 50	12.9
T Camelop.	30.4	+65 57	12.1 *i*	U Draconis	9.9	+67 7	13.2
– Tauri	32.8	+ 8 9	13.1	S Sagittarii	13.6	−19 12	<10.0
X Camelop.	32.6	+74 56	12.2*d*	U Lyrae	16.6	+37 42	10.3
R Orionis	53.6	+ 759	11.2 *i*	R Cygni	34.1	+49 58	<11.0
R Leporis	55.0	−14 57	8.3 *i*	TT Cygni	37.1	+32 23	8.0
V Orionis	5 0.8	+ 3 58	11.5 *i*	RT Cygni	40.8	+48 32	11.2 *i*
R Aurigae	9.2	+53 28	8.7*d*	TU Cygni	43.3	+48 49	10.2*d*
S Aurigae	20.5	+34 4	8.8 *i*	χ Cygni	46.7	+32 40	7.7
W Aurigae	20.1	+36 49	<13.0	SV Cygni	20 6.5	+47 35	9.4
S Camelop.	30.2	+68 45	8.8	S Aquilae	7.0	+15 19	10.5
U Aurigae	35.6	+31 59	<12.0	RW Aquilae	7.3	+15 46	8.7
SU Tauri	43.2	+19 2	10.0	RS Cygni	9.8	+38 28	7.6
Z Tauri	46.7	+15 46	13.4	R Delphini	10.1	+ 8 47	11.6
U Orionis	49.9	+20 10	10.6*d*	RT Capricorni	11.3	−21 38	7.0
V Camelop.	49.4	+74 30	<14.0	SX Cygni	11.6	+30 46	<12.0
Z Aurigae	53.6	+53 18	9.9	V Sagittae	15.8	+20 47	12.2
V Monoc.	6 17.7	− 2 9	12.3	U Cygni	16.5	+47 35	11.1
U Lyncis	31.8	+59 57	14.0	SZ Cygni	29.6	+46 16	9.3
Nova Gem. No.2	45.5	+32 17	7.9	ST Cygni	29.9	+54 38	10.8
R Lyncis	53.0	+55 28	10.1 *i*	Y Delphini	36.9	+11 31	<13.0
V Can.Min.	7 1.5	+ 9 2	10.2*d*	S Delphini	38.5	+16 44	9.6
RR Monoc.	12.4	+ 1 17	11.0 *i*	V Cygni	38.1	+47 47	8.9
S Can.Min.	27.3	+ 8 32	<11.0	T Delphini	40.7	+16 2	10.3
U Can.Min.	35.9	+ 8 37	9.2*d*	T Aquarii	44.7	− 5 31	8.0 *i*

Approximate Magnitudes of Variable Stars on Dec. 1, 1912.

Continued.

Name.	R. A. 1900. h m	Decl. 1900. ° ′	Magn.	Name.	R.A. 1900 h m	Decl. 1900 ° ′	Magn.
RZ Cygni	20 48.5	+46 59	11.2*d*	Y Pegasi	22 6.8	+13 52	<13.0
R Vulpeculae	59.9	+23 26	8.7*i*	RS Pegasi	7.4	+14 4	12.5
RS Capric.	21 1.7	−16 49	7.8	S Lacertae	24.6	+39 48	11.5 *i*
TW Cygni	1.8	+29 0	11.2	R Lacertae	38.8	+41 51	<12.0
VV Cygni	2.3	+45 23	13.1	S Aquarii	51.8	−20 53	9.4*d*
X Cephei	3.6	+82 40	9.8	RW Pegasi	59.2	+14 46	<13.0
R Equulei	8.4	+12 23	10.3 *i*	R Pegasi	23 1.6	+10 0	8.2
T Cephei	8.2	+68 5	7.6*d*	V Cassiop.	7.4	+59 8	11.3*d*
RR Aquarii	9.8	− 3 19	<12.0	W Pegasi	14.8	+25 44	10.3
T Capricorni	16.5	−15 35	10.3	ST Androm.	33.8	+35 13	9.3*d*
W Cygni	32.2	+44 56	5.3	R Aquarii	38.6	−15 50	9.7*d*
S Cephei	36.5	+78 10	<11.0	Z Cassiop.	39.7	+56 2	<13.0
RU Cygni	37.3	+53 52	8.1	R Cassiop.	53.3	+50 50	11.7
RV Cygni	39.1	+37 34	8.0	V Ceti	52.8	− 9 31	<13.0
V Pegasi	56.0	+ 5 38	8.2	Y Cassiop.	58.2	+55 7	10.0
RT Pegasi	59.8	+34 38	11.1	SV Androm.	59.2	+39 33	10.8 *i*
T Pegasi	22 4.0	+12 3	<13.0				

The letter *i* denotes that the light is increasing; the letter *d*, that the light is decreasing; the sign < that the variable is fainter than the appended magnitude.

The above magnitudes have been compiled at the Harvard College Observatory from observations made by the following observers:—T. C. H. Bouton, H. C. Bancroft, Jr., A.P.C. Craig, T. Dunham, Jr., E. L. Forsyth, C. E. Furness, E. Gray, F. E. Hathorn, S. E. Hunter, M.W. Jacobs Jr., J.B. Lacchini, C. Y. McAteer, W.T. Olcott, P.G. O'Reilley, F. C. Leonard, G. M. Ritchie, F. E. Seagrave, H. M. Swartz, D. Todd, J. M. White, I. E. Woods, H. W. Vrooman, and A. S. Young.

Minima of Variable Stars of Short Period.

[Calculated by Myrtle L. Richmond, E. R. Peterson and S. N. Stearns at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time; to obtain eastern Standard time subtract 5^h; Central Standard 6^h. etc.

Star	R. A. 1900 h m	Decl. 1900 ° ′	Magnitude	Approx. Period d h	Greenwich mean time of minima in **February** 1913 d h d h d h d h
SY Androm.	0 08.0	+43 09	9.5—13.0	34 21.9	22 5
RT Sculptor	31.5	−26 13	9.6—10.5	0 12.3	7 5; 14 21; 22 13;
UU Androm.	38.5	+30 24	10.7—11.9	1 11.7	5 20; 13 7; 20 17; 28 3
U Cephei	0 53.4	+81 20	7.0— 9.0	2 11.8	2 8; 9 19; 17 6; 24 18
Z Persei	2 33.7	+41 46	9.4—12	3 01.4	6 20; 12 22; 19 1; 25 4
RY Persei	39.0	+47 43	8.0—10.3	6 20.7	3 5; 10 1; 16 22; 23 19
RZ Cassiop.	39.9	+69 13	6.4— 7.8	1 04.7	6 17; 13 21; 20 25; 28 5
ST Persei	53.7	+38 47	8.5—10.5	2 15.6	7 12; 15 10; 23 9
RX Cassiop.	2 58.8	+67 11	8.6— 9.1	32 07.6	6 13
Algol	3 01.7	+40 34	2.3— 3.5	2 20.8	5 6; 16 16; 22 10; 28 4
RT Persei	16.7	+46 12	9.5—11.5	0 20.4	7 0; 13 19; 20 4; 27 9
λ Tauri	55.1	+12 12	3.4— 4.5	3 22.9	8 0; 15 21; 23 19
RW Tauri	3 57.8	+27 51	7.1—<11	2 18.5	2 4; 10 11; 18 18; 27 2
RV Persei	4 04.2	+33 59	9.5—11.0	1 23.4	6 18; 12 16; 18 14; 24 12
RW Persei	13.3	+42 04	8.8—11.0	13 04.8	7 22; 21 3
SZ Tauri	31.4	+18 20	7.2— 7.7	3 03.6	1 22; 8 5; 20 19; 27 2
RS Cephei	4 48.6	+80 06	9.5—12.0	12 10.1	11 19; 24 5
TT Aurigae	5 02.8	+39 27	7.8— 8.7	0 16.0	6 14; 13 6; 19 22; 26 13
RY Aurigae	11.5	+38 13	10.7—11.7	2 17.5	3 7; 14 5; 19 16; 25 3
RZ Aurigae	42.9	+31 40	10.6—13.3	3 00.3	5 15; 11 15; 17 16; 23 16
SV Tauri	45.8	+28 05	9.4—11.0	2 04.0	2 11; 8 23; 21 23; 28 11

Minima of Variable Stars of Short Period.—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in **February** 1913
	h m	° ′	.	d h	d h d h d h d h d h
SV Gemin.	5 54.6	+24 28	9.8—<11	4 00.2	1 11; 9 11; 17 11; 25 12
RW Gemin.	5 55.4	+23 08	9.5—11.0	2 20.8	2 8; 8 1; 19 12; 25 6
U Columbae	6 11.2	−33 03	9.4—10.2	2 19.2	1 15; 7 5. 18 10; 24 0
SX Gemin.	22.0	+20 37	10.8—11.5	1 08.8	3 5; 8 16; 19 15; 25 2
RU Monoc.	29.3	+ 8 54	9.0—10.8	1 21.7	1 5; 8 20; 16 11; 24 2
RX Gemin.	43.6	+33 21	8.8— 9.6	12 05.0	2 6; 14 11; 26 16
RW Monoc.	6 49.4	− 7 28	9.8—10.5	0 21.5	3 1; 10 5; 17 9; 24 13
R Can. Maj.	7 14.9	−16 12	5.8— 6.4	1 03.3	1 1; 9 17; 21 2; 26 18
RY Gemin.	21.7	+15 52	8.9—<10	9 07.2	2 0; 11 8; 20 15
Y Camelop.	27.6	+76 17	9.5— 12	3 07.3	4 15; 11 6; 17 21; 24 11
RR Puppis	43.5	−41 08	9.5—	6 10.3	6 21; 13 7; 19 18; 26 4
V Puppis	7 55.4	−48 58	4.1— 5.8	1 10.9	7 10; 14 17; 22 0
X Carinae	8 29.1	−58 53	7.9— 8.7	0 13.0	1 23; 7 9; 18 5; 23 15
S Cancri	38.2	+19 24	8.2—10	9 11.6	9 14; 19 1; 28 13
S Antliae	27.9	−28 11	6.7— 7.8	0 07.8	6 7; 12 19; 19 6; 25 19
S Velorum	28.5	−44 46	7.8— 9.1	5 22.4	4 15; 10 13; 22 10; 28 8
Y Leonis	9 31.1	+26 41	9.3—11.2	1 16.5	9 3; 17 13; 25 23
RR Velorum	10 17.8	−41 36	10.0—10.9	1 20.5	6 18; 16 0; 25 7
SS Carinae	10 54.2	−61 23	12.2—12.8	3 07.2	5 18; 12 9; 18 23; 25 14
ST Urs. Maj.	11 22.4	+45 44	6.7— 7.2	8 19.2	5 5; 14 0; 22 19
RW Urs. Maj.	35.4	+52 34	9.3—10.3	7 07.9	1 19; 9 3; 16 11; 23 19
Z Draconis	11 40.6	+72 49	9.5—12.5	1 08.6	2 18; 9 12; 16 6; 23 1
SS Centauri	13 07.2	−63 37	8.8—10.4	2 11.5	7 3; 14 13; 22 0
δ Librae	14 55·6	− 8 07	5. — 6.7	2 07.9	2 4; 9 4; 16 3; 23 3
U Coronae	15 14.1	+32 01	7.6— 8.7	3 10.9	7 15; 14 13; 21 11; 28 9
TW Draconis	32.4	+64 14	7.0— 8.9	2 19.4	8 9; 16 19; 25 5
114.1908 Librae	15 43.4	−15 14	9.3—11.5	0 18.4	8 14; 16 5; 23 21
SW Ophiuchi	16 11.1	− 6 44	9.2—10.0	2 10.7	1 3; 8 11; 15 19; 23 3
SX Ophiuchi	12.6	− 6 25	10.5—11.2	2 01.5	7 12; 15 18; 24 0
R Arae	31.1	−56 48	6.7— 8.	4 10.2	5 10; 14 6; 23 3
TT Herculis	16 49.9	+17 00	8.9— 9.3	20 18.1	4 20; 14 13; 25 15
TU Herculis	17 09.8	+30 50	9.5—12	2 06.4	2 18; 9 14; 16 9; 23 4
U Ophiuchi	11.5	+ 1 19	6.0— 6.7	0 20.1	7 9; 15 18; 24 4
u Herculis	13.6	+33 12	5.1— 5.6	2 01.2	2 15; 8 19; 21 2; 27 6
TX Herculis	15.4	+42 00	8.3— 9.0	1 00.7	4 16; 11 21; 19 2; 26 8
RV Ophiuchi	29.8	+ 7 19	9. —<11	3 16.5	6 5; 13 14; 20 23; 28 8
SZ Herculis	36.0	+33 01	9.5—10.3	0 19.6	5 4; 13 8; 21 13
TX Scorpii	48.6	−34 13	7.5— 8.2	0 22.6	7 1; 14 14; 22 3
Z Herculis	53.6	+15 09	7.1— 7.9	3 23.8	7 4; 15 4; 23 3
WX Sagittae	53.6	−17 24	9.2—10.8	2 36.6	3 19; 10 4; 16 14; 22 23
WY Sagittae	17 54.9	−23 1	9.5—10.6	4 16.0	4 11; 13 19; 23 3; 27 19
SX Draconis	18 03.0	+58 23	9.3—10.5	5 04.1	6 3; 11 7; 21 15; 26 19
RS Sagittarii	11.0	−34 08	5.9— 6.3	2 10.0	7 4; 14 10; 21 16; 28 22
V Serpentis	11.1	−15 34	9.5—11.1	3 10.9	4 16; 11 13; 18 11; 25 9
RZ Scuti	21.1	− 9 15	7.4— 8.3	15 3.2	6 21; 22 0
RZ Draconis	21.8	+58 50	9.5—10.2	0 13.2	1 18; 7 6; 18 7; 23 19
RX Herculis	26.0	+12 32	7.0— 7.6	0 21.3	5 10; 14 8; 23 5
SX Sagittarii	39.7	−30 36	8.6— 9.4	2 01.8	4 1; 10 7; 22 18; 26 22
RR Draconis	40.8	+62 34	8.5—<12	2 19.9	4 23; 13 11; 21 23
RS Scuti	43.7	−10 21	9.3—10.3	0 15.9	3 5; 9 21; 16 12; 23 4
β Lyrae	46.4	+33 15	3.4— 4.5	12 21.8	12 9; 25 7
U Scuti	18 48.9	−12 44	9.0— 9.8	0 22.9	6 18; 16 8; 25 21
RX Draconis	19 01.1	+58 35	9.3—10.2	1 21.5	7 10; 14 23; 22 13
RV Lyrae	12.5	+32 15	11. —13	3 14.4	5 6; 12 11; 19 16; 26 20
RS Vulpec.	13.4	+22 16	6.9— 8.0	4 11.4	1 11; 10 10; 19 9; 28 8
U Sagittae	14.4	+19 26	6.7— 9.0	3 09.1	2 2; 8 20; 15 14; 22 9
Z Vulpec.	17.5	+25 23	7.3— 8.5	2 10.9	5 21; 13 6; 20 15; 28 0
TT Lyrae	24.3	+41 30	9.0—<11	5 05.8	2 6; 12 18; 23 5; 28 11

Minima of Variable Stars of Short Period—Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of minima in February 1913.
	h m	° ′		d h	d h d h d h d h d h
120.1907 Draconis	19 26.2	+68 44	9.3—10	1 15.1	5 8; 11 20; 18 9; 24 21
SY Cygni	19 42.7	+32 28	10 —12	6 00.2	5 4; 11 5; 17 5; 23 5
WW Cygni	20 00.6	+41 18	9.5—12.5	3 07.6	2 9; 9 0; 22 6; 28 22
SW Cygni	03.8	+46 01	9. —12	4 13.8	9 3; 18 6; 27 10
VW Cygni	11.4	+34 12	9.5—11.5	8 10.3	6 4; 14 14; 23 0
RW Capric.	12.2	−17 59	8.8—10.6	3 09.4	7 12; 14 7; 21 2; 27 21
UW Cygni	19.6	+42 55	10.5—13	3 10.8	5 0; 11 22; 18 19; 25 17
V Vulpec.	32.3	+26 15	8.0— 9.0	37 19.0	13 12
W Delphini	33.1	+17 56	9.5—11.5	4 19.4	9 2; 18 16; 28 7
RR Delphini	38.9	+13 35	10.5—11.8	4 14.4	3 9; 12 13; 21 18
Y Cygni	48.1	+34 17	7.1— 7.9	1 12.0	2 6; 9 18; 17 5; 24 17
WZ Cygni	49.3	+38 27	9.8—10.8	0 14.0	6 3; 11 23; 17 20; 23 16
RR Vulpec.	20 50.5	+27 32	9.6—11.0	5 01.2	3 11; 13 13; 23 15; 28 17
VV Cygni	21 02.3	+45 23	12.1—13.8	1 11.4	4 17; 12 2; 19 12; 26 21
AE Cygni	09.0	+30 20	10.8—11.4	0 23.3	5 3; 14 19; 24 12
UZ Cygni	55.2	+43 52	9. —11.5	31 07.3	13 6
RT Lacertae	21 57.4	+43 24	9.1—10.5	5 01.7	3 9; 13 12; 23 16; 28 17
RW Lacertae	22 40.6	+49 08	10.2—11.2	5 04.4	4 6; 9 10; 19 19; 24 23
X Lacertae	22 45.0	+55 54	8.2— 8.6	5 10.6	3 0; 8 11; 19 8; 24 18
TT Androm	23 08.7	+45 36	10.5—11.3	2 18.3	4 0; 12 7; 20 14; 28 21
Y Piscium	29.3	+ 7 22	9.0—12.0	3 18.4	6 7; 13 19; 21 8; 28 21
TW Androm	23 58.2	+32 17	8.6—11.5	4 02.9	9 4; 17 10; 25 16

Maxima of Variable Stars of Short Period.

[Calculated by May E. Abbott, Hazel H. Barnard, Helen A. Orr, and Myrtle L. Richmond at Goodsell Observatory.]

Given to the nearest hour in Greenwich mean time. To obtain Eastern standard time subtract 5h; Central standard time 6h etc.

Star	R.A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in Februuary 1913.
	h m	° ′		d h	d h d h d h d h d h
SX Cassiop.	0 05.5	+54 20	8.6— 9.4	36 13.7	14 9
SV Cassiop.	0 09.8	+57 52	9.3— 9.9	4 1.7	1 2; 9 6; 17 9; 25 12
RR Ceti	1 27.0	+ 0 50	8.3— 9.0	0 13.3	8 13; 16 7; 24 1
RW Cassiop.	1 30.7	+57 15	8.9—11.0	14 19.2	1 12; 16 7
VArietis	2 09.6	+11 46	8.3— 9.0	0 23.8	6 11; 14 10; 22 8
SU Cassiop.	2 43.0	+68 28	6.5— 7.0	1 22.8	2 12; 10 7; 18 2; 25 22
TU Persei	3 01.8	+52 49	11.4—12.2	0 14.6	3 6; 10 13; 17 16; 25 2
RW Camelop.	3 46.2	+58 21	8.2— 9.4	16 00.0	10 9; 26 0
SX Persei	4 10.2	+41 27	10.4—11.2	4 06.9	2 19; 11 9; 19 23; 28 13
SV Persei	42.8	+42 07	8.8— 9.6	11 03.1	1 10; 12 13; 23 16
RX Aurigae	4 54.5	+39 49	7.2— 8.1	11 15.0	4 17; 16 8; 27 23
SX Aurigae	5 04.6	+42 02	8.0— 8.7	1 12.8	7 5; 14 21; 22 12
SY Aurigae	05.5	+42 42	8.4— 9.5	10 03.3	11 3; 21 6
Y Aurigae	21.6	+42 21	8.6— 9.6	3 20.6	5 11; 13 4; 20 22; 28 15
RZ Gemin.	5 56.6	+22 15	9.1—10.0	5 12.7	1 5; 12 7; 23 8; 28 21
RS Orionis	6 16.5	+14 43	7.8— 8.5	7 13.4	1 11; 9 0; 16 13; 24 3
T Monoc.	19.8	+ 7 08	5.7— 6.8	27 00.3	18 5
RZ Camelop.	23.7	+67 06	11.0—13.0	0 11.5	7 10; 14 15; 21 20
W Gemin.	29.2	+15 24	6.8— 7.6	7 22.0	5 23; 13 21; 21 19
ζ Gemin.	6 58.2	+20 43	3.7— 4.5	10 03.7	10 12; 20 16
RU Camelop.	7 10.9	+69 51	8.5— 9.8	22 06.5	3 11; 25 18

Maxima of Variable Stars of Short Period.

Continued.

Star	R. A. 1900	Decl. 1900	Magnitude	Approx. Period	Greenwich mean times of maxima in February 1913.
	h m	° ′		d h	d h d h d h d h
RR Gemin.	7 15.2	+31 04	10.0—11.5	0 09.5	3 22; 11 20; 19 19; 27 18
V Carinae	8 26.7	−59 47	7.2— 8.0	6 16.7	1 9; 8 2; 21 11; 28 4
T Velorum	8 34.4	−47 01	7.5— 8.5	4 15.3	2 4; 11 10; 20 17
W Carinae	9 19.2	−55 32	7.5— 8.5	4 08.9	8 19; 17 12; 26 6
W Ursae Maj.	9 36.7	+56 24	7.9— 8.6	0 04.0	6 22; 13 14; 20 6; 26 22
RR Leonis	10 02.1	+24 03	9.1—10.1	0 10.9	6 10; 13 5; 20 0; 26 19
SW Draconis	11 32.2	+67 53	8.9— 9.6	0 16.0	7 2; 13 17; 20 7; 26 22
S Muscae	12 07.4	−69 36	6.5— 7.3	9 15.8	10 9; 20 1
SU Draconis	12.8	+70 04	8.8— 9.6	0 13.7	2 8; 10 7; 18 7; 26 6
T Crucis	15.9	−61 44	6.8— 7.6	6 17.6	2 11; 9 4; 15 22; 22 15
R Crucis	18.1	−61 04	6.8— 8.0	5 19.8	4 18; 10 14; 22 6; 28 2
S Crucis	48.4	−57 53	6.6— 7.8	4 16.6	2 5; 11 15; 21 0; 25 16
RZ Centauri	12 55.6	−64 05	8.5— 8.9	1 21.0	4 17; 12 5; 19 17; 27 5
W Virginis	13 20.9	− 2 52	8·7—10.4	17 06.5	7 16; 24 22
RV Ursae Maj.	13 29.4	+54 31	9.2— 9.9	0 11.2	7 5; 14 6; 21 6; 28 7
ST Virginis	14 22.5	− 0 27	10.3—11.4	0 09.9	2 15; 10 20; 19 1; 27 6
V Centauri	25.4	−56 27	6.4— 7.8	5 11.9	6 6; 17 6; 22 18; 28 5
RS Bootis	29.3	+32 11	8.9—10.0	0 09.1	6 14; 14 3; 21 16
RU Bootis	14 41.5	+23 44	12.8—14.3	0 11.9	1 11; 8 21; 16 7; 23 17
R Triang. Austr.	15 10.8	−66 08	6.7— 7.4	3 09.3	1 15; 8 10; 21 23; 28 18
S Triang. Austr.	15 52.2	−63 29	6.4— 7.4	6 07.8	4 16; 11 0; 17 8; 23 15
S Normae	16 10.6	−57 39	6.5— 7.4	9 18.1	9 4; 18 22; 28 16
RW Draconis	33.7	+58 03	9.6—10.8	0 10.6	9 0; 17 21; 26 17
RV Scorpii	16 51.8	−33 27	6.7— 7.4	6 01.5	4 1; 10 3; 22 6; 28 7
X Sagittarii	17 41.3	−27 48	4.4— 5.0	7 00.3	3 0; 10 0; 17 0; 24 1
Y Ophiuchi	47.3	− 6 07	6.1— 6.5	17 02.9	6 14; 23 17
U Sagittarii	17 58.6	−29 35	4.3— 5.1	7 14.3	1 14; 9 5; 16 19; 24 9
Y Sagittarii	18 15.5	−18 54	5.4— 6.2	5 18.6	6 3; 11 22; 17 16; 23 11
U Sagittarii	26.0	−19 12	6.5— 7.3	6 17.9	5 19; 12 13; 19 7; 26 1
Y Scuti	32.6	− 8 27	8.7— 9.2	10 08.3	5 5; 15 13; 25 21
Y Lyrae	34.2	+43 52	11.3—12.3	0 12.1	2 21; 8 22; 21 0; 27 1
RZ Lyrae	39.9	+32 42	9.9—11.2	0 12.3	7 3; 13 6; 19 10; 25 13
RT Scuti	44.1	−10 30	9.1— 9.7	0 11.9	5 20; 11 18; 17 17; 23 16
κ Pavonis	18 46.6	−67 22	3.8— 5.2	9 02.2	3 11; 12 14; 21 16
U Aquilae	19 24.0	− 7 15	6.2— 6.9	7 00.6	1 1; 8 2; 15 2; 22 3
XZ Cygni	30.4	+56 10	8.7— 9.3	0 11.2	5 13; 12 13; 19 13; 26 13
U Vulpec.	32.2	+20 07	6.9— 7.6	7 23.5	3 6; 11 6; 19 5; 27 5
SU Cygni	40.8	+29 01	6.6— 7.4	3 20.3	3 1; 10 17; 18 10; 26 3
η Aquilae	47.4	+ 0 45	3.7— 4.5	7 04.2	1 11; 8 15; 15 19; 22 23
S Sagittae	51.5	+16 22	5.6— 6.4	8 09.2	7 3; 15 12; 23 22
X Vulpec.	19 53.3	+26 17	9.5—10.5	6 07.7	3 3; 15 18; 22 2; 28 9
XX Cygni	20 01.3	+58 40	10.5—11.5	0 03.2	3 14; 10 8; 17 2; 23 20
X Cygni	39.5	+35 14	6.0— 7.0	16 09.3	10 5; 26 14
T Vulpec.	47.2	+27 52	5.5— 6.5	4 10.5	3 22; 12 18; 21 15; 26 2
WY Cygni	52.3	+30 03	9.5—10.3	0 13.5	3 22; 10 16; 17 9; 24 2
RV Capric.	55.9	−15 37	9.2—10.1	0 10.7	5 16; 12 9; 19 2; 25 20
TX Cygni	20 56.4	+42 12	8.5— 9.7	14 17.4	12 10; 27 3
VY Cygni	21 00.4	+39 34	8.9— 9.5	7 20.6	6 11; 14 7; 22 4
VY Cygni	21 47.7	+42 40	8.4— 9.2	4 20.7	1 1; 10 18; 20 12; 25 8
Y Lacertae	22 05.2	+50 33	9.1— 9.6	4 07.8	5 6; 14 1; 22 17
δ Cephei	25.5	+57 54	3.7— 4.6	5 08.8	6 3; 16 20; 22 5; 27 14
Z Lacertae	36.9	+56 18	8.2— 9.0	10 21.1	3 19; 14 16; 25 13
RR Lacertae	37.5	+55 55	8.5— 9.2	6 10.1	1 22; 14 18; 21 4; 27 14
V Lacertae	22 44.5	+55 48	8.2— 8.9	4 23.6	1 21; 11 20; 21 19; 26 19
SW Cassiop	23 03.7	+58 11	9.2— 9.7	5 10.6	1 6; 12 3; 23 0; 28 11
RS Cassiop	32.6	+61 52	9.1—10.0	6 07.1	1 21; 14 12; 20 19; 27 2
RY Cassiop	47.2	+58 11	9.2—10.0	12 03.4	15 2; 27 6
U Pegasi	23 52.9	+15 24	9.3— 9.9	0 04.5	2 12; 10 0; 17 12; 25 0

Maxima and Minima of Variable Stars of Short Period:—It will be noticed that in this issue the headings given to the lists of variables with the predicted times of maxima or minima are not the same as they were formerly. The division formerly was made on the basis that certain stars varied in their light intensity according to the same law as the well known star Algol and that others varied according to some other law. Since the refined methods of measuring the light changes show that Algol itself is no longer uniform at maximum, but is undergoing a constant change within narrow limits, the division into Algol and non-Algol stars is no longer appropriate. The two lists are now constructed so that in the one are included all the stars whose times of minima are given, and in the other those whose times of maxima are given. The lists in general are not very greatly changed because of the new basis of division. In a few instances stars formerly among the non-Algol type whose minimum were predicted have been transferred to the other list. Any one desiring to use these lists will find that whenever such transfer has been made the insertion is made in the order of right ascension, and no confusion can arise because of it.

Suspected Variable 26.1912 Geminorum.—Regarding the variability of this star, which is BD. +32° 1433, and very near to the Nova (2) Geminorum, and which has been announced as a suspected variable by Dr. A. Kühl of Munich in *A. N.* 4578, and in *P. A.* 197, I should like to record that casual observations of it, made by me while observing the Nova, tend to confirm the fact that the star is slightly variable. I have not tried to make any definite estimates of it for want of bright enough comparison stars in proximity to it, but it has often seemed slightly variable, (to the amount of a few tenths of a mag.), in its light.

FREDERICK C. LEONARD.

A New Variable 32.1912 Andromedae:—This star, whose approximate place for 1855 is $\alpha = 23^h\ 31^m\ 32^s$ $\delta = +\ 34°\ 44'$ and which does not appear in the BD. catalogue, was used by me as a comparison star for ST Andromedae, and from this work it appears that the comparison star itself is slightly variable. From a comparison with near by stars it is seen that this star varies between the $9^m.7$ and $10^m.2$. From three minima a period of 1.9195 days was derived. Further observations would indicate that the period is only one half as long as the above. However, these later observations may not be reliable in which case it is necessary to revert to the former period. The color was visually estimated as a whitish yellow. [Extract from note by L. Pračka in *A. N.* 4614:]

A New Variable 33.1912 Pegasi:—In comparing stereoscopically two of my plates of the star cluster, Messier 15, made in 1897 and 1910, M. Balanowsky has found a star of 10-11 magnitude which was easily visible on one of the plates but did not appear on the other. From a study of all of the plates of this region the variability of this star is confirmed. It has an amplitude of 2 or 3 magnitudes and a period probably long or irregular. [Extract from note by S. Kostinsky in *A. N.* 4614.]

New Elements for X Cygni and RU Camelopardalis:—In *A. N.* 4614 M. Luizet concludes from a discussion of 795 comparisons made since 1898 by the Argelander method that the maximum and minimum brightness of X Cygni recur with regularity, and that the period is $16^d\ 9^h\ 15^m\ 1^s.2$. But the range of light

change is not constant. The brightness at maximum varies between the limits $6^m.2$ and $6^m.5$ and at minimum between $7^m.2$ and $7^m.4$. From this point of view X Cygni has the characteristics of most of the stars of long period. He assigns the following new elements to this star

$$\text{Max.} = 2410190.684 \text{ (M.T. Paris)} + 16^d.38543 \text{ E.}$$

These differ very little from those formerly given to this star.

In the same paper M. Luizet gives the following as his determination of the elements for the variable RU Camelopardalis.

$$\text{Min.} = 2417610.96 + 22^d.172 \text{ E.}$$

These elements verify the period given by Ichinohe in *A. N.* 4319, but the time of the initial epoch is slightly changed.

New Elements of the Variable T Vulpeculae:—M. M. Luizet, in Bulletin Astronomique for November 1912, draws the following conclusions in regard to the variable T Vulpeculae from a discussion of 788 determinations of its relative brightness made by himself begun in 1898: The star is of the δ Cephei type; its period $4^d\ 10^h\ 27^m\ 9^s.0$; its brightness diminishes during 0.7 of its period; it increases during 1.30 days according to his light curve for this star, and during 1.36 days according to all the observations made since 1885. The new elements assigned to it are:

$$\text{Max} = 2409849.085 \text{ (Paris M. T.)} + 4^d.435521 \text{ E.}$$

Recent Observations of Nova (2) Geminorum.—Since the Nova (2) Geminorum passed into the morning sky, attempts have been made to observe it at least once a week; now, however, that it has re-appeared in the evening, observations upon it may be expected more frequently. Following are given all of my observations of the Nova made subsequent to those published in my article in the August and September P. A. Morning observations, or those made after midnight of the preceding civil day, are indicated by a dagger (†). Telescope, 3-inch equatorial refractor.

OBSERVATIONS OF NOVA (2) GEMINORUM

1912, Aug. 31-Nov. 15.

Date	Mag.	Color	Comparison Stars
Aug. 31†	7.8	Pinkish white	BD.+32° 1433, 1434, 1437
Sept. 8†	7.7	Very light *greenish* white	BD.+32° 1433 and 1437
Sept. 26†	7.8	Very pale green	BD.+32° 1433 and 1437
Oct. 5†	8.2	Greenish white	BD.+32° 1433, 1434, 1437
Oct. 13†	7.7	Very pale green	BD.+32° 1433, 1434, 1437
Oct. 19†	7.6	Very light greenish blue	BD.+32° 1433 and 1437
Oct. 27†	7.5	Very light greenish blue	BD.+32° 1433 and 1437
Nov. 2†	7.6	Very light greenish blue	BD.+32° 1433, 1434, 1437
Nov. 4	7.7	Very light greenish blue	BD.+32° 1433 and 1437
Nov. 10	7.7	Very light greenish blue	BD.+32° 1433, 1434, 1437
Nov. 15	8.0	Very light greenish blue	BD.+32° 1433, 1434, 1437

The (BD.) magnitudes and positions of all of the comparison stars, with the exception of one, used in the foregoing estimates, have been printed in my papers in the May and June-July P.A.'s, respectively. These data for the additional one, herein, are as follows, (1855.0):

BD. + 32° 1434, mag. 8.6, $\alpha\ 6^h\ 44^m\ 46^s.6$, $\delta + 32°\ 28'.9$.

It will be seen, that while the Nova has been visible in the early morning, through the present time, its light fluctuations have been comparatively small, indicating no decisive rise or decline,* but merely a succession of slight variations, amounting to only a few tenths of a magnitude, above and below what may be termed its normal brightness for this period, which, based upon the mean of these observations, is approximately mag. 7.75. The color, too, for the most part, has been about the same throughout this time, being, instead of a reddish hue, (which we might naturally expect from former observations), of a greenish tinge, (except in the first observation, when it was probably pinkish). During the last six observations, it has been very light greenish blue without any alteration.

The Nova is indeed a most interesting and instructive body to follow and it is my belief that much systematic and continued study of it will, in the whole, be sure to acquaint us more fully with the mysterious phenomena characteristic of these so-called new stars.

FREDERICK C. LEONARD.

1338 Madison Park, Chicago, Ill.,
1912, November 16.

COMET AND ASTEROID NOTES.

Comet 1912 *a* is circumpolar now, being in the constellation Draco, near the star ω on January 1. It is moving northward about 50′ daily and growing slowly fainter. It can still be seen with a small telescope, but is no longer conspicuous. The following ephemeris is a portion of one given in the *Lick Observatory Bulletin* No. 222, computed by Professor R. T. Crawford from the elements in *Bulletin* No. 218 (See POPULAR ASTRONOMY, November 1912, p. 603), which have proved to be very accurate.

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT.

1913	True α			True δ			log Δ	Brightness
	h	m	s	°	′	″		
Jan. 1.5	17	33	39.7	+69	06	45		
2.5		37	23.7	69	56	51		
3.5		41	32.4	70	46	51	0.1474	0.10
4.5		45	37.5	71	36	43		
5.5		50	11.1	72	26	23		
6.5	17	55	05.6	73	15	48		
7.5	18	00	23.9	+74	04	55	0.1548	0.09

Comet 1912 *b* **(Schaumasse-Tuttle)** is circumpolar in the southern heavens, being in the constellation Centaurus, not far from the star α, on January 1.

Comet 1912 *c* is in Aquarius near the star μ on January 1 but is too faint to be observed except with large telescopes. The elements and ephemeris by Mr. R. K. Young, which follow, are quite accurate and will enable possessors of large telescopes to follow the comet for some time yet.

* The extent of variation, as defined by the times of greatest and least brightness, mag. 7.5 on Oct. 27 and 8.2 on Oct. 5, respectively, being 0.7 magnitude.

Borrelly's Comet, 1912 *c*.—Borrelly's comet, 1912 *c*, has been observed here on four nights with the 3-inch refractor. It was first picked up on the evening of 1912, Nov. 8, when it was roughly of the ninth stellar magnitude, about 3′ in angular diameter, apparently circular and nearly uniformly bright, and faint in the telescope. On this date, it was approximately 3° south of β Lyrae. On the following night, (Nov. 9), it was found to be slightly brighter than on the preceding evening, and the same in general aspect. On November 10, it was estimated at between the 8.5 and 9.0 magnitude. The last observation, made November 14, was rather difficult to obtain on account of moonlight. The comet resembled a faint blur in the telescope, with no nucleus, and was somewhat large in comparison with Gale's Comet, (1912 *a*). It was then quite near to a number of very faint stars.

FREDERICK C. LEONARD.

1338 Madison Pk., Chicago, Ill.,
1912, December 8.

Elements and Ephemeris of Comet *c* 1912.—The following observations of comet *c* 1912 received by letter from the Lick Observatory have been made the basis of an orbit. The final elements are based on the first, third and fourth observations, the second being used as a check.

Mt. H. M. T.	App. α	App. δ	Observer
d h m s	h m s	° ′ ″	
Nov. 4 6 59 52	18 05 58.68	+35 05 47.6	Aitken
" 7 7 13 16	18 26 53.88	30 12 14.9	"
" 11 7 01 13	18 49 40.96	24 07 33.5	"
" 20 6 13 50	19 26 52.13	+12 53 49.7	Pitman

The final elements are,

T	Oct. 20.8597 G.M.T.		
ω	99° 31′ 53″.4	99° 31′ 53″.7	
Ω	143 45 51 .8 1912.0	143 46 42 .4	1913.0
i	124 42 13 .6	124 42 13 .2	
log q	0.043856		

CONSTANTS FOR THE EQUATOR 1912.0.

$$x = r\,[9.941505]\,\sin(32^\circ\ 10'\ 44''.5 + v)$$
$$y = r\,[9.740671]\,\sin(179\ 41\ 04\ .9 + v)$$
$$z = r\,[9.984992]\,\sin(113\ 37\ 30\ .7 + v)$$

CONSTANTS FOR THE EQUATOR 1913.0.

$$x = r\,[9.941549]\,\sin(32^\circ\ 10'\ 6''.8 + v)$$
$$y = r\,[9.740542]\,\sin(179\ 40\ 24\ .9 + v)$$
$$z = r\,[9.984997]\,\sin(113\ 37\ 12\ .6 + v)$$

These elements represent observations as follows:

	I	II	III	IV
	″	″	″	″
(O–C) $\Delta\alpha \cos\delta$	−0.1	−2.5	+0.0	+0.3
(O–C) $\Delta\delta$	−2.4	−1.1	+0.0	−1.0

EPHEMERIS FOR GREENWICH MEAN MIDNIGHT.

Date	True α	True δ	log Δ	Br.
1912-13	h m s	° ′ ″		
Dec. 4.5	20 04 03.3	+ 1 27 10	0.2112	0.26
5.5	20 06 10.7	0 50 17		
6.5	20 08 15.3	+ 0 14 44		
7.5	20 10 17.2	− 0 19 33		
8.5	20 12 16.5	0 52 39	0.2388	0.22
9.5	20 14 13.2	1 24 37		
10.5	20 16 07.4	1 55 29		
11.5	20 17 59.3	2 25 17		
12.5	20 19 49.0	2 54 05	0.2646	0.19
13.5	20 21 36.4	3 21 57		
14.5	20 23 21.8	3 48 53		
15.5	20 25 05.3	4 14 56		
16.5	20 26 47.1	4 40 09	0.2887	0.16
17.5	20 28 27.3	5 04 34		
18.5	20 30 06.0	5 28 14		
19.5	20 31 43.2	5 51 09		
20.5	20 33 18.9	6 13 22	0.3110	0.13
21.5	20 34 53.2	6 34 55		
22.5	20 36 26.2	6 55 50		
23.5	20 37 57.9	7 16 07		
24.5	20 39 28.5	7 35 48	0.3316	0.11
25.5	20 40 57.9	7 54 56		
26.5	20 42 26.3	8 13 32		
27.5	20 43 53.6	8 31 36		
28.5	20 45 19.8	8 49 09	0.3507	0.10
29.5	20 46 45.1	9 06 14		
30.5	20 48 09.5	9 22 52		
31.5	20 49 33.0	9 39 02		
Jan. 1.5	20 50 55.7	9 54 45	0.3684	0.09
2.5	20 52 17.7	10 10 05		
3.5	20 53 38.8	10 25 01		
4.5	20 54 59.1	10 39 34		
5.5	20 56 18.8	10 53 46	0.3847	0.08
6.5	20 57 37.7	11 07 37		
7.5	20 58 56.0	11 21 07		
8.5	21 00 13.5	11 34 18		
9.5	21 01 30.5	11 47 11	0.3996	0.07
10.5	21 02 46.8	11 59 46		
11.5	21 04 02.6	12 12 04		
12.5	21 05 17.7	12 24 05		
13.5	21 06 32.3	12 35 50	0.4134	0.06
14.5	21 07 46.3	12 47 20		
15.5	21 08 59.8	12 58 36		
16.5	21 10 12.7	13 09 38		
17.5	21 11 25.2	13 20 26	0.4260	0.05
18.5	21 12 37.1	13 31 01		
19.5	21 13 48.5	13 41 24		
20.5	21 14 59.4	13 51 35		
21.5	21 16 09.9	14 01 35	0.4375	0.05
22.5	21 17 19.9	14 11 24		
23.5	21 18 29.5	14 21 03		
24.5	21 19 38.6	14 30 31		
25.5	21 20 47.3	14 39 51	0.4480	0.04
26.5	21 21 55.5	14 49 00		
27.5	21 23 03.4	14 58 06		
28.5	21 24 10.8	15 06 53		
29.5	21 25 17.8	−15 15 38	0.4576	0.04

Brightness Nov. 4, taken as unity.

REYNOLD K. YOUNG.

University of Kansas. Dec. 10.

NOTES FOR OBSERVERS.

Monthly Report of the American Association of Variable Star Observers, Nov.-Dec. 1912.—It is gratifying to announce that this report includes the largest number of observations contributed by the Association in any one month, 1087, a fine record, and the best indication of the continued prosperity of the Association. We have also broken our record for the number of variables observed in any one month, 117 having been under observation during the past month.

It is a great pleasure to welcome as a member of our association Mr. N. V. Ginori, of Florence, Italy, a member of the V. S. S. of the B. A. A., and an experienced observer of variable stars. Mr. Ginori has contributed two valuable monographs to the literature of the subject, discussions of the variables Eta Aquilae and SU Draconis, and will prove a valuable addition to our ranks.

Six of our observers contributed over 100 observations each this month. Mr. Craig has the credit for the longest list, comprising 155 observations. When it is added that Mr. Craig observes with a 2-inch refractor, and the quality of his estimates is most excellent, his fine record is deserving of the highest commendation.

Mr. Jacobs obtained a splendid set of observations of the variable 213843 SS Cygni as it was rising on the night of December 3. His five observations on that night, made at hourly intervals, indicate clearly the rapidity of the rise. I doubt if there is any object observable in the heavens with a small telescope that can exceed in interest and wonder the sight of this variable star when it is rising. It is truly astounding to watch the increase in light of this great and far distant sun, and reflect on the baffling mystery the scene presents. If Sirius exhibited the same phenomena it would command the attention of the world. The variable rose last on October 3,—this rise therefore records a 61 day period.

Miss J. White has taken Miss Sutton's place as Assistant to Dr. Caroline E. Furness, Director of the Vassar College Observatory. Miss White's observations are indicated by the letter "W".

Obvious mistakes of misidentification are evident in some cases. Observers concerned where there are wide variances are requested to use special care in observations of these stars.

The dates of maxima during the month of several of our variables calculated by Hartwig follows, the approximate magnitude as observed being given for the respective dates:—

050953	R Aurigae	(6.5)	Nov. 23	9.0	waning
103769	R Urs. Maj.	(5.9)	4	9.0	"
163266	R Draconis	(6.4)	26	8.0	
180531	T Herculis	(6.9)	18	8.0	
181136	W Lyrae	(7.3)	13	8.5	waxing
194632	Chi Cygni	(4.2)	5	6.0	
200415	S Aquilae	(8.4)	20	10.5	
201647	U Cygni	(6.1)	17	11.0	
205923	R Vulpeculae	(7.1)	12	9.4	waxing

The interesting variable 074922 U Geminorum is now favorably situated for observing in the early evening, and all observers are urged to observe it frequently. Members of the Association are also requested to observe the variable 123961 S Urs. Maj. at every opportunity. Observations of this variable have a special value.

Mr. Otto Mach of Dayton, Ohio, contributes observations for the first time in this report under the abbreviation "Ma".

VARIABLE STAR OBSERVATIONS NOV.–DEC. 1912.

001726
T Androm.

Mo.	Day	Est.	Obs.
11	2	8.7	G
	3	9.5	O
	6	9.5	O
	11	9.6	O
	12	9.5	G
	14	9.9	G
	16	10.7	S
	16	9.8	O
	16	9.8	Y
	18	10.0	Y
	30	11.0	Y
	30	10.5	G

001755
T Cassiop.

Mo.	Day	Est.	Obs.
11	1	9.1	L
	2	8.7	G
	5	9.4	C
	8	9.2	Bu
	8	9.0	C
	9	9.0	L
	9	9.0	G
	10	9.2	Bu
	11	9.3	J
	16	9.5	Bu
	16	9.1	J
	18	9.2	J
	20	9.2	Bu
	23	9.4	Bu
	29	9.5	Bu
	29	9.3	J
	30	8.7	Y
	30	8.6	G
	30	9.5	Bu
12	2	9.2	J
	6	9.3	J

001838
R Androm.

Mo.	Day	Est.	Obs.
11	9	10.8	Hu
	28	10.1	V
12	3	12.3	Hu

003179
Y Cephei

Mo.	Day	Est.	Obs.
11	16	12.4	Hu

004047
U Cassiop.

Mo.	Day	Est.	Obs.
11	3	9.2	O
	6	9.0	O
	9	8.8	G
	16	8.9	G
	17	9.3	F
	18	9.3	Y
	18	9.5	S
	29	9.5	G
	30	9.7	Y

004435
V Androm.

Mo.	Day	Est.	Obs.
12	3	13.0	Hu

004533
RR Androm.

Mo.	Day	Est.	Obs.
11	4	12.2	O
	14	12.6	Hu
12	3	11.3	Hu

004958
W Cassiop.

Mo.	Day	Est.	Obs.
11	11	11.7	J
	16	11.1	J
	18	11.1	J
	26	11.3	J
	29	11.0	J
12	1	11.1	J
	2	10.9	J
	3	11.0	J
	6	11.0	J
	7	10·9	J

011208
S Piscium

Mo.	Day	Est.	Obs.
11	3	10.7	O
	4	11.1	O

012502
R Piscium

Mo.	Day	Est.	Obs.
11	16	11.6	Y
	29	10.2	Y
12	3	9.1	O
	3	9.1	S

013238
RU Androm.

Mo.	Day	Est.	Obs.
11	16	13.8	J

013338
Y Androm.

Mo.	Day	Est.	Obs.
11	11	10.3	J
	17	11.1	J
	29	11.6	J
12	2	12.2	J
	8	12.6	J

014958
X Cassiop.

Mo.	Day	Est.	Obs.
11	1	11.1	L

021024
R Arietis

Mo.	Day	Est.	Obs.
11	8	10.4	Bu
	10	10.4	Bu

021143 a
W Androm.

Mo.	Day	Est.	Obs.
10	10	9.4	F
11	14	8.9	W

021258
T Persei

Mo.	Day	Est.	Obs.
11	2	9.0	G
	4	9.0	G
	5	9.1	C
	6	8.9	O
	6	9.0	C
	8	9.2	C
	10	9.0	G
	11	9.2	C
	11	8.9	O
	14	9.2	G
	16	9.0	O
	18	9.2	C
	27	8.9	G
	28	9.2	C
	30	9.4	C

021403
o Ceti

Mo.	Day	Est.	Obs.
10	31	8.7	L
11	2	8.7	G
	2	8.7	O
	4	8.6	L
	4	8.4	F
	4	8.8	G
	5	8.6	C
	6	8.8	C
	8	8.4	Bu
	9	8.8	L
	9	8.5	F
	10	8.4	V
	10	8.6	O
	10	8.4	Bu
	10	8.7	G
	11	8.9	C
	12	8.8	L
	12	8.8	G
	14	8.9	C
	14	9.0	Hu
	16	8.8	O
	17	9.0	F
	17	8.6	V
	27	8.8	G
	28	8.8	V
	28	9.0	C
	28	8.6	F
	29	8.8	O
	29	8.8	Bu
	30	8.8	Bu
	30	8.8	G
12	3	9.0	O
	4	8.9	V
	7	9.0	O
	7	8.2	Hu

021558
S Persei

Mo.	Day	Est.	Obs.
11	2	9.3	G
	3	9.2	O
	4	8.9	G
	5	9.3	C
	6	9.3	C
	6	9.0	O
	8	9.1	C
	10	9.1	G
	11	9.1	C
	11	8.8	O
	14	9.0	G
	16	8.8	S
	16	9.0	O
	18	9.0	C
	27	8.8	G
	28	9.2	C
	30	9.1	C
12	3	8.7	B
	9	9.1	O

022813
U Ceti

Mo.	Day	Est.	Obs.
11	8	10.2	Bu
	10	10.0	Bu
	30	10.2	Bu

023133
R Trianguli

Mo.	Day	Est.	Obs.
11	3	10.7	O
	8	10.2	O
	9	10.9	G
	16	11.0	Y
	29	11.2	Y

024356
W Persei

Mo.	Day	Est.	Obs.
11	3	9.2	O
	8	9.2	Le
	10	9.0	V
	10	9.3	Le
	10	9.0	G
	14	9.3	Le
	14	9.4	G
	15	9.4	Le
	16	9.4	Le
	17	9.1	V
	17	9.3	Le
	18	9.3	Le
	21	9.3	Le
	28	9.0	V
	28	9.0	G
	28	9.3	Le
	29	9.3	Le
12	1	9.5	Hu
	4	9.0	V
	4	9.4	Le
	5	9.1	Le
	6	9.1	Le
	9	9.2	O

030514
U Arietis

Mo.	Day	Est.	Obs.
11	16	13.3	Y
	29	13.1	Y

031401
X Ceti

Mo.	Day	Est.	Obs.
11	4	11.4	F
	9	11.2	F
	17	10.2	F

032043
Y Persei

Mo.	Day	Est.	Obs.
11	3	9.5	O
	6	9.3	O
	10	8.4	G
	11	8.5	O
	12	8.8	G
	14	8.5	G
	15	8.5	F
	16	8.5	O
	18	8.5	O
	27	8.5	G
12	1	8.5	Hu
	3	8.6	B
	6	8.7	O

032335
R Persei

Mo.	Day	Est.	Obs.
11	16	9.0	Y
	18	8.8	S
	21	8.5	Y
	29	8.5	Y
	30	8.9	S
12	7	8.9	S

042215
W Tauri

Mo.	Day	Est.	Obs.
11	16	12.0	Y
	29	12.1	Y

042209
R Tauri

Mo.	Day	Est.	Obs.
11	30	8.4	Fu

043065
T Camelop.

Mo.	Day	Est.	Obs.
11	16	13.0	Y
	30	12.0	Y

043274
X Camelop.

Mo.	Day	Est.	Obs.
11	2	10.3	O
	6	10.6	O
	16	11.9	Y
	30	12.4	Y

045307
R Orionis

Mo.	Day	Est.	Obs.
11	18	11.5	Y
	30	11.1	Y

VARIABLE STAR OBSERVATIONS Nov.–Dec. 1912.—Continued.

045514
R Leporis

Mo.	Day	Est.	Obs.
11	4	8.8	F
	7	9.5	L
	8	9.4	C
	10	9.5	F
	12	9.2	G
	13	9.6	L
	14	9.3	C
	17	9.0	F
	18	9.1	C
	27	8.4	G
	28	8.3	G
	30	9.0	Bu
12	2	8.3	G

050003
V Orionis

11	18	12.2	Y
	30	11.6	Y

050953
R Aurigae

11	4	8.6	G
	6	8.6	C
	8	8.6	C
	9	8.9	J
	10	8.5	O
	11	8.9	J
	16	9.1	J
	16	9.0	O
	16	8.6	Y
	18	9.1	J
	26	9.2	J
	27	8.7	G
	29	9.3	J
	29	8.5	O
	30	8.7	Y
12	2	9.2	J
	3	9.3	J
	3	8.7	O
	6	8.4	B
	6	9.3	J

052036
W Aurigae

11	29	11.0	O
12	7	11.0	O

052034
S Aurigae

11	8	9.9	L
	18	8.5	Y
	29	9.3	Y

053068
S Camelop.

11	16	8.7	Y
	30	8.8	Y

054319
SU Tauri

11	16	9.8	Y
	29	9.8	Y

054920
U Orionis

11	4	10.2	F
	5	10.2	C
	6	10.0	C
	8	10.5	C
	9	10.1	F
	11	11.0	C
	14	10.7	C
	15	10.0	F
	18	9.6	S
	18	10.1	C
	20	10.0	Bu
	19	10.2	Bu
	30	11.0	Hu
	30	9.7	S
	30	8.6	Ba

055353
Z Aurigae

11	16	9.6	Y
	29	9.9	Y

065355
R Lyncis

11	9	11.5	J
	11	10.9	J
	16	10.8	J
	16	10.8	Y
	29	10.0	J
	29	10.1	Y
12	2	10.0	J
	3	10.0	J
	6	10.0	J

070122 a
R Geminorum.

12	7	8.9	Hu

072708
S Can. Min.

12	8	10.8	M

073508
U Can. Min.

10	28	9.0	L
11	4	8.6	F
	7	9.0	L
	9	8.5	F
	13	9.1	L
	17	8.9	F
12	2	9.0	G

074922
U Geminorum

11	9	12.1	J
12	2	13.9	J

081112
R Cancri

10	28	9.7	L
11	7	10.0	L
	13	10.0	L
	14	10.0	C
	18	10.0	C

085120
T Cancri

11	7	9.0	L
	13	8.9	L

093178
Y Draconis

11	16	8.7	Y
	30	8.9	Y

094211
R Leonis

11	7	10.3	L
	13	10.3	L
	14	9.8	C
	18	10.0	C

103212
U Hydrae

11	14	5.8	C
	18	5.9	C

103769
R Urs. Maj.

11	4	8.9	L
	6	9.0	C
	8	9.2	L
	8	9.0	C
	8	9.2	Bu
	10	9.2	Bu
	10	8.9	F
	11	9.0	C
	12	9.5	M
	12	9.4	L
	13	9.5	L
	14	9.6	C
	16	9.5	Bu
	16	9.9	S
	17	10.0	J
	18	10.0	C
	18	9.7	Y
	19	9.7	M
	21	9.8	M
	23	9.4	Bu
	25	10.2	L
	29	9.4	Bu
	29	10 8	J

R Urs. Maj.

11	30	9.7	Bu
	30	10.6	B
	30	10.6	S
12	2	10.9	J
	6	10.9	J

123160
T Urs. Maj.

10	28	9.2	L
11	7	8.4	L
	8	9.0	Bu
	9	8.3	L
	10	9.0	Bu
	12	8.9	M
	13	8.2	L
	16	8.8	Bu
	18	8.4	C
	18	8.4	Y
	18	8.2	J
	21	8.8	M
	23	8.4	Bu
	25	8.2	L
	29	8.6	J
	29	8.5	Bu
	30	7.7	S
	30	8.1	M
	30	8.4	Bu
12	5	7.9	M
	8	8.1	J

123961
S Urs. Maj.

10	28	9.2	L
11	7	8.6	L
	8	9.0	Bu
	9	8.7	L
	10	8.8	Bu
	10	8.6	F
	12	9.2	M
	13	8.6	L
	16	9.0	Bu
	18	8.6	J
	18	8.6	C
	18	8.5	Y
	19	8.9	M
	21	8.8	M
	23	8.6	Bu
	25	8.5	L
	29	8.4	J
	29	8.6	Bu
	30	8.4	Bu
	30	8.7	M
	30	9.2	S
12	5	8.6	M
	8	8.6	J

132706
S Virginis

11	3	7.1	L
	25	7.2	L

134440
R Can. Ven.

11	7	11.7	L
	21	11.5	M

141567
U Urs. Min.

11	8	11.2	Bu
	10	11.2	Bu
	29	11.9	J
12	8	12.1	J

141954
S Boötis

10	28	9.5	L
11	1	9.5	L
	12	8.2	G
	13	9.6	L
	18	10.1	J
	30	10.5	J

142539
V Boötis

10	28	8.0	L
11	1	7.9	L
	7	7.9	L
	13	8.0	L
	25	7.8	L

142584
R Camelop.

10	28	9.5	L
11	2	10.0	O
	4	9.5	L
	4	9.5	G
	6	10.1	O
	8	10.3	L
	9	10.5	J
	10	9.7	G
	11	10.5	J
	12	10.5	L
	16	10.5	J
	16	10.3	Bu
	16	10.2	G
	18	10.5	B
	20	10.2	Bu
	23	10.3	Bu
	29	10.5	Bu
	30	10.5	Bu
	30	11.0	B

143227
R Boötis

10	28	6.8	L
11	1	6.9	L
	7	7.0	L
	13	6.9	L
	25	7.5	L

VARIABLE STAR OBSERVATIONS Nov.–Dec. 1912.—Continued.

153378
S Urs. Min.

Mo	Day	Est.	Obs.
10	28	8.2	L
11	4	8.4	L
	4	8.2	G
	8	8.3	L
	10	8.2	G
	12	8.3	L
	25	8.4	L
12	2	8.4	G

154428
R Cor. Bor.

10	28	6.0	L
11	1	6.0	L
	4	6.0	F
	5	6.0	C
	6	5.8	C
	7	6.0	L
	7	6.0	F
	7	6.1	Ma
	8	6.0	C
	9	5.8	C
	10	6.4	G
	10	6.0	Ma
	11	5.9	C
	13	6.4	L
	13	5.7	C
	14	5.9	C
	15	6.0	F
	29	6.4	J

155847
X Herculis

11	1	6.0	L
	7	5.9	L
	13	6.2	L
	25	6.0	L

160625
RU Herculis

11	30	7.6	B

162119
U Herculis

11	8	11.5	Bu
	9	10.0	F
	10	11.4	Bu
	18	11.2	Y

163172
R Urs. Min.

11	8	9.6	Bu
	10	9.6	Bu
	16	9.8	Bu

163266
R Draconis

10	28	9.1	L
11	4	8.5	L

R Draconis

Mo.	Day	Est.	Obs.
11	4	8.5	F
	5	8.3	C
	6	8.3	C
	7	8.2	L
	8	8.2	C
	8	8.2	Bu
	8	8.2	O
	9	8.0	L
	9	8.1	J
	10	8.4	F
	10	8.2	Bu
	11	8.2	J
	11	8.3	C
	11	8.3	Y
	12	7.9	L
	13	8.2	C
	14	8.2	C
	16	8.1	Y
	17	8.1	F
	18	8.0	S
	18	7.9	J
	23	8.0	Bu
	25	7.8	L
	26	8.2	M
	28	8.1	M
	28	8.1	C
	28	8.2	F
	29	8.0	Y
	29	7.8	Bu
	30	8.1	J
	30	8.0	C
12	2	8.1	J
	4	7.9	B
	6	7.9	J
	7	8.1	S

164715
S Herculis

11	8	8.7	Bu
	8	8.1	C
	9	8.3	C
	9	8.6	J
	11	8.4	C
	13	8.4	C
	14	8.5	C
	16	8.5	Bu
	18	8.0	J
	28	8.3	C
	29	7.9	J
	30	8.2	Bu
	30	8.1	J

165631
RV Herculis

11	8	10.5	O
	12	10.6	G
	16	11.2	Y
	30	12.8	Y

175458
T Draconis

Mo.	Day	Est.	Obs.
11	6	10.3	O
	10	10.7	G
	28	11.0	F

180531
T Herculis

11	3	9.0	O
	5	9.2	C
	6	9.0	C
	6	8.7	O
	7	8.8	F
	8	8.7	C
	8	8.7	Bu
	9	8.5	F
	10	8.5	V
	10	8.6	O
	11	8.3	C
	12	8.6	G
	13	8.3	C
	14	8.3	C
	15	8.3	V
	16	8.4	O
	16	8.5	Bu
	18	8.1	B
	18	8.3	V
	22	8.2	V
	22	7.4	M
	26	7.6	M
	28	8.2	C
	28	8.1	V
	29	7.7	M
	30	7.8	G
	30	8.2	C
	30	8.5	Bu
12	3	8.2	M
	4	8.2	V

181136
W Lyrae

11	3	8.9	O
	5	8.8	O
	5	8.6	C
	6	8.5	C
	8	8.7	Bu
	8	8.6	C
	10	8.6	G
	10	8.7	O
	11	8.6	C
	13	8.6	C
	14	8.5	C
	14	8.4	G
	16	8.6	O
	16	8.7	Y
	16	8.4	Bu
	16	8.3	G
	27	7.9	G
	28	8.2	C

W Lyrae

Mo.	Day	Est.	Obs.
11	29	8.0	Y
	30	8.0	C
	30	8.2	Bu
	30	7.7	G
12	2	7.6	G

184205
R Scuti

10	28	5.5	L
11	4	5.9	F
	5	5.5	C
	6	5.7	C
	7	5.5	L
	8	5.7	C
	8	5.8	O
	8	5.6	Bu
	10	5.9	F
	10	5.1	Ma
	11	5.5	Ma
	11	5.7	C
	12	5.5	Ma
	13	5.6	L
	13	5.7	C
	14	5.7	C
	15	5.6	Ma
	16	5.6	Ma
	18	5.4	M
	18	5.4	Ma
	20	6.0	L
	23	5.9	L
	25	5.9	L
	28	6.7	F
	28	6.1	C
	28	6.2	M
	30	6.5	C

190967
U Draconis

11	16	12.3	Hu

191019
R Sagittarii

11	4	10.0	F
	10	8.3	F
	15	8.3	F
	18	8.4	F

191350
TZ Cygni

11	1	11.0	L
	12	10.8	L

191517
U Lyrae

11	5	9.5	Fu
	18	10.0	Fu
	29	10.2	Fu

193449
R Cygni

Mo.	Day	Est.	Obs.
11	16	11.3	B
	27	11.2	Ha
	30	11.2	B
12	4	11.2	B
	7	12.0	Ba
	7	13.0	M

193732
TT Cygni

11	4	8.1	F
	5	8.6	C
	6	8.5	C
	8	8.5	C
	9	8.0	F
	10	8.1	O
	11	8.6	C
	12	8.1	F
	16	8.4	O
	17	8.0	F
	28	7.7	G
	28	8.1	F
	28	8.4	C
	29	8.0	O
12	3	8.4	O
	9	8.3	O

194048
RT Cygni

10	28	9.9	L
11	1	10.2	L
	2	9.8	O
	3	9.3	F
	4	10.2	L
	4	9.4	G
	5	9.6	C
	6	9.3	C
	7	10.4	L
	8	9.8	Bu
	8	9.7	C
	9	10.0	F
	9	10.0	M
	10	10.5	O
	10	10.0	G
	11	10.0	C
	11	9.8	M
	12	10.0	F
	12	10.5	L
	14	10.5	G
	16	9.8	B
	16	10.2	Bu
	17	10.1	F
	18	10.6	M
	27	10.8	G
	28	11.0	F
	28	11.3	M
	30	10.9	B
	30	11.2	G

VARIABLE STAR OBSERVATIONS Nov.–Dec. 1912.—Continued.

RT Cygni

Mo.	Day	Est	Obs.
12	2	11.5	G
	4	10.9	B
	7	11.8	Ba

194232

SY Cygni

Mo.	Day	Est	Obs.
11	17	10.3	F

194358

TU Cygni

Mo.	Day	Est	Obs.
11	3	9.0	F
	8	10.4	Bu
	8	9.6	C
	9	10.0	M
	9	9.0	F
	11	9.3	C
	11	9.8	M
	12	9.0	F
	17	9.0	F
	18	9.6	M
	26	10.4	M
	28	10.5	M
	28	9.3	F

194632

χ Cygni

Mo.	Day	Est	Obs.
10	30	5.8	L
11	2	6.2	O
	3	6.0	F
	4	5.5	G
	4	6.2	L
	4	6.1	F
	5	6.5	C
	6	6.4	O
	6	6.7	C
	7	6.1	L
	8	6.5	Bu
	8	7.0	C
	9	6.3	F
	9	6.5	J
	10	6.2	G
	10	6.7	Bu
	10	6.7	O
	11	6.7	J
	11	7.2	C
	12	6.4	G
	12	6.5	L
	13	6.8	L
	14	7.2	C
	14	6.4	G
	16	6.7	Bu
	16	7.0	O
	16	7.0	B
	17	6.5	F
	18	7.1	M
	18	7.0	J
	20	7.3	L
	23	6.9	Bu
	25	7.4	L
	26	7.9	J

χ Cygni

Mo.	Day	Est	Obs.
11	26	7.3	M
	27	6.9	G
	27	7.5	Ha
	28	8.3	C
	28	7.5	F
	28	7.4	M
	29	7.9	O
	29	7.0	Bu
	30	6.8	Bu
	30	7.8	Hu
	30	7.8	B
	30	8.0	J
12	2	7.2	G
	2	8.3	J
	3	8.4	O
	3	8.8	J
	4	7.9	B
	6	8.6	J
	6	8.7	O
	7	8.7	O
	7	8.6	J
	7	8.6	Ba
	7	8.0	Hu
	9	8.7	O

200647

SV Cygni

Mo.	Day	Est	Obs.
11	4	9.0	F
	5	9.3	C
	6	9.4	C
	6	9.5	O
	8	9.5	C
	9	8.8	F
	9	8.7	Hu
	10	9.4	O
	11	9.5	C
	11	9.3	M
	12	9.0	G
	12	9.0	F
	15	8.4	F
	16	8.9	B
	16	9.4	O
	17	9.2	F
	27	9.4	G
	28	9.6	C
	28	9.0	F
	28	9.4	M
	29	9.5	O
	30	9.0	B
	30	9.0	Hu
12	3	9.5	O
	4	8.6	B
	7	9.5	O
	7	9.4	Ba
	7	8.9	Hu

200715 a

S Aquilae

Mo.	Day	Est	Obs.
11	4	10.0	F
	9	10.6	F

S Aquilae

Mo.	Day	Est.	Obs.
11	15	10.4	F
	28	11.1	F
	30	10.7	B
12	1	10.8	M

200715 b

RW Aquilae

Mo.	Day	Est	Obs.
11	4	9.0	F
	9	8.9	F
	15	8.8	F
	28	9.0	F
	30	9.5	B
12	1	8.6	M
	3	9.2	M

200822

W Capricorni

Mo.	Day	Est	Obs.
11	9	9.5	F
	15	9.5	F

200916

R Sagittae

Mo.	Day	Est	Obs.
11	4	8.8	F
	5	9.2	W
	9	9.1	F
	12	9.2	W
	15	9.2	F
	19	9.1	W
	28	9.2	F
	30	9.0	B

200938

RS Cygni

Mo.	Day	Est	Obs.
11	4	7.2	F
	4	7.5	G
	6	7.8	C
	8	7.9	C
	9	7.2	F
	10	7.1	G
	10	7.5	O
	11	8.0	C
	11	8.2	G
	12	7.3	F
	14	7.3	G
	16	7.5	O
	16	8.4	J
	17	7.0	F
	18	8.3	J
	22	8.3	J
	27	7.2	G
	27	8.0	Ha
	28	7.0	F
	28	8.0	C
	29	7.5	O
	29	8.3	J
12	2	8.2	J
	3	7.5	O
	6	8.3	J

201121

RT Capricorni

Mo.	Day	Est.	Obs.
11	5	7.0	F
	9	7.0	F
	10	6.7	G
	12	6.8	F
	12	6.7	G
	15	6.7	F
	18	6.7	F
	27	6.8	G
	28	6.7	F
	30	6.7	G

201647

U Cygni

Mo.	Day	Est	Obs.
11	4	10.2	F
	4	11.5	L
	8	11.5	L
	9	10.8	G
	9	9.5	F
	11	11.6	J
	12	10.0	F
	18	11.4	J
	22	11.4	J
	26	11.4	J
	27	10.7	G
	28	10.5	F
	29	11.3	J
12	2	11.4	J
	6	11.5	J

202846

TV Cygni

Mo.	Day	Est	Obs.
10	28	9.6	L
11	7	9.9	L
	12	10.0	L

202946

SZ Cygni

Mo.	Day	Est	Obs.
10	28	9.0	L
11	2	8.9	G
	4	10.0	F
	4	9.2	G
	5	9.9	C
	6	10.5	C
	7	9.7	L
	8	9.7	Le
	8	10.0	C
	8	9.8	Bu
	9	10.0	F
	9	9.2	G
	10	9.6	Le
	10	9.6	Bu
	10	9.6	G
	10	9.5	O
	11	9.4	C
	12	9.0	F
	12	9.1	L
	12	9.4	G
	14	8.8	G
	14	9.3	Le

SZ Cygni

Mo.	Day	Est.	Obs.
11	15	9.2	Le
	16	8.7	Bu
	16	9.2	Le
	16	9.0	B
	17	9.4	F
	17	9.4	Le
	18	9.6	Le
	20	8.9	Bu
	23	9.8	Bu
	27	8.8	G
	28	8.9	G
	28	9.1	Le
	28	9.2	F
	29	8.8	Ba
	29	9.2	Le
	29	9.4	Bu
	30	8.9	B
	30	8.6	Bu
	30	9.3	G
12	2	9.5	G
	4	9.5	Le
	5	9.7	Le
	6	9.7	B
	6	9.8	Le
	7	10.3	Ba
	7	9.4	Hu

203816

S Delphini

Mo.	Day	Est.	Obs.
11	16	9.7	Y
	29	9.8	Y

203847

V Cygni

Mo.	Day	Est	Obs.
11	12	9.2	G
	28	8.9	G

204016

T Delphini

Mo.	Day	Est.	Obs.
11	16	10.6	Y
	29	10.3	Y

204405

T Aquarii

Mo.	Day	Est	Obs.
11	4	9.5	O
	6	9.5	C
	8	9.4	C
	10	8.9	V
	10	9.3	O
	11	9.4	J
	11	9.4	C
	14	9.5	G
	16	8.9	Hu
	18	8.5	V
	18	8.8	J
	26	7.7	J
	28	7.9	V
	30	8.0	J
12	2	9.2	G
	3	7.7	J
	4	7.4	V
	7	7.6	J

VARIABLE STAR OBSERVATIONS NOV.–DEC. 1912.—Continued.

205923
R Vulpeculae

Mo.	Day	Est.	Obs.
11	1	10.7	L
	6	9.5	O
	7	9.9	L
	8	9.7	Bu
	10	9.5	Bu
	10	9.4	O
	11	10.3	J
	12	9.1	L
	12	9.3	W
	13	9.1	L
	16	9.5	Bu
	18	9.2	J
	19	9.2	W
	20	8.9	L
	22	9.1	J
	25	8.8	L
	29	8.6	O
	30	8.9	J
12	2	8.7	J
	3	8.7	J
	3	8.5	O
	6	8.3	J
	7	8.4	J
	7	8.5	O

210116
RS Capricorni

11	5	8.4	C
	6	8.1	C
	8	8.4	C
	9	8.0	F
	10	8.0	G
	11	8.4	C
	18	7.8	F
	27	7.7	G
	28	8.7	F
	28	8.3	C

210612
R Equulei

11	5	11.9	Fu
	18	11.0	Fu
	29	10.7	Fu

210868
T Cephei

11	1	6.6	L
	5	7.5	C
	6	6.7	O
	6	7.0	C
	7	6.5	L
	8	7.1	C
	8	7.0	Bu
	9	7.1	M
	9	6.7	L
	10	6.9	V
	10	7.0	Bu
	11	7.2	M
	11	7.1	C

T Cephei

Mo.	Day	Est.	Obs.
11	12	6.8	L
	14	7.3	C
	16	6.7	S
	16	7.2	Bu
	17	7.3	J
	17	7.1	V
	18	7.3	O
	18	7.7	M
	18	7.5	J
	20	7.0	Bu
	22	7.1	V
	23	7.2	Bu
	25	7.2	L
	26	8.0	M
	28	8.1	M
	28	7.1	V
	28	7.2	G
	28	7.7	C
	29	7.2	Bu
	29	7.5	J
	29	8.0	O
	30	7.2	Bu
12	2	7.9	J
	3	8.0	O
	4	7.3	V
	6	8.1	J
	7	7.7	Ba
	9	8.2	O

211615
T Capricorni

11	27	10.5	G
	30	10.2	G

213244
W Cygni

10	28	5.2	L
11	2	5.7	G
	4	5.4	L
	5	5.8	C
	6	5.7	C
	8	6.4	Bu
	8	5.9	C
	8	5.3	L
	11	5.6	C
	12	5.4	L
	16	6.2	Bu
	20	5.4	L
	25	5.4	L
	27	5.4	G
	28	5.9	C
	30	5.4	G
12	2	5.2	G

213678
S Cephei

11	14	10.0	Hu

213753
RU Cygni

Mo.	Day	Est.	Obs.
11	5	8.1	C
	6	8.1	C
	8	8.2	C
	11	8.3	C
	17	8.2	F
	28	8.0	G
	28	8.1	C

213843
SS Cygni

11	8	11.9	L
	9	12.0	J
	10	11.9	Hu
	11	11.9	J
	16	11.3	Hu
	16	11.9	J
	18	11.9	J
	19	11.9	J
	20	11.9	J
	22	11.9	J
	26	12.0	J
	28	11.7	M
	29	10.8	M
	29	11.9	J
	30	11.6	Hu
	30	11.1	Y
	30	11.9	J
	30	11.8	B
12	1	11.9	J
	2	11.5	J
		11.6	J
		11.6	J
	3	9.9	O
		9.7	O
	3	9.8	S
	3	9.6	M
	3	10.3	J
		10.2	J
		10.2	J
		10.1	J
		9.8	J
	4	8.5	G
	6	8.2	J
	6	8.5	O
	7	8.2	J
	7	8.4	O
	7	8.6	S
	7	8.7	Ba
	9	8.3	O

213937
RV Cygni

11	4	7.3	F
	8	8.2	Bu
	8	8.0	Le
	9	7.5	F
	9	8.4	J
	10	8.0	Le
	11	8.5	J
	12	7.6	F

RV Cygni

Mo.	Day	Est.	Obs.
11	14	7.9	Le
	15	8.0	Le
	16	8.0	Le
	16	8.5	J
	16	8.0	Bu
	16	7.4	B
	17	7.8	Le
	17	7.5	F
	18	8.0	Le
	21	7.8	Le
	22	7.7	Le
	22	8.2	J
	28	8.1	Le
	28	7.2	G
	28	7.6	F
	29	8.0	Le
	29	8.3	J
	29	8.0	Bu
	30	7.8	Bu
	30	7.2	B
12	2	7.1	G
	2	8.5	J
	3	7.2	O
	4	8.0	Le
	5	8.2	Le
	6	8.0	Le
	6	8.5	J
	6	7.4	B
	7	7.4	Hu

215305
V Pegasi

11	5	8.3	W
	12	8.2	W
	19	8.3	W

222439
S Lacertae

11	6	12.0	Y
	30	12.5	Y

225120
S Aquarii

11	18	9.1	Fu
	30	9.4	Fu

230110
R Pegasi

11	2	7.6	O
	2	7.6	G
	6	7.6	O
	9	7.5	G
	11	7.8	O
	14	7.5	G
	29	8.2	O
	30	8.3	Y
12	2	8.1	G
	3	8.1	O
	7	8.4	O

230759
V Cassiopeiae

Mo.	Day	Est.	Obs.
11	4	10.4	F
	9	10.4	J
	10	10.3	V
	10	10.3	G
	11	10.6	J
	16	10.9	G
	16	10.7	J
	17	11.0	F
	18	10.8	J
	29	11.4	J
12	2	11.6	J
	6	11.7	J

231425
W Pegasi

11	10	10.1	V
	28	10.3	V

233335
ST Androm.

11	2	9.4	G
	6	9.1	O
	9	9.2	Hu
	12	9.5	G
	16	8.8	S
	23	9.3	Bu
	29	9.5	Bu
	30	9.3	Ba
	30	9.7	Bu
	30	10.2	G
12	3	8.8	Hu
	7	9.0	S
	7	9.4	Ba
	7	8.8	O

233815
R Aquarii

11	6	9.8	C
	8	9.7	C
	11	9.6	C
	12	9.4	G

235350
R Cassiop.

11	1	11.4	L
	8	10.7	C
	17	9.0	F
12	2	11.8	J
	6	11.7	J

235939
SU Androm.

11	16	11.0	Y
	30	10.9	Y

VARIABLE STAR OBSERVATIONS.—Nov.-Dec., 1912,—Continued.

NOVA GEMIN. 2.

Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.	Mo.	Day	Est.	Obs.
10	28	7.9	L	11	8	7.8	C	11	12	8.1	L	11	19	7.9	M	11	30	8.1	M
11	4	8.0	L		10	8.5	Bu		12	7.8	G		20	8.0	L		30	8.5	Bu
	4	7.6	G		10	7.8	G		14	8.0	C		23	8.8	Bu	12	2	8.1	G
	5	7.8	C		11	7.9	C		16	8.8	Bu		25	7.8	L		3	7.8	O
	6	7.9	C		12	8.3	M		18	7.8	C		28	8.0	G		5	7.8	M
	7	8.0	L														7	7.8	O

No. of observations, 1087; Stars observed, 117; Observers, 18.

Mr. Hunter calls special attention to the intense red color of the variable 213937 RV Cygni. As this star is irregular it should be observed frequently.

It remains to qualify somewhat a statement that appeared in the October report anent the comparison of the work of our Association during the past year with that of the work of the V.S.S. of the B.A.A. It appears that the latter organization does not confine its attention solely to the observation of the long period variables as we do, consequently a comparison is hardly just. In addition, as far as quality is concerned, we can hardly expect as yet to compete with the excellent work done in England, which is contributing, under the able direction of Mr. C. L. Brook, valuable date to the cause of Astro-physics. Mr. Brook very kindly extends to the association his sincere congratulations on the progress we have made, and I feel that I voice the sentiments of all our members when I say that we are very grateful for these words of encouragement from kindred spirits across the seas.

WM. TYLER OLCOTT.
Corresponding Sec'y.

Norwich, Ct., Dec. 10, 1912.

GENERAL NOTES.

Professor M. Andoyer, of the Nice Observatory has been chosen to succeed the late M. Henri Poincaré in the professorship of mathematical astronomy at the University of Paris.

At its last meeting the Rumford Comittee of the American Academy of Arts and Sciences made the following appropriations: to G. W. Ritchey, of Pasadena, $500 for the construction of a reflecting telescope employing mirrors with new forms of curves; to Professor Edward L. Nichols, of Cornell University, $250 for the construction of a new form of electro magnet, to be used in an investigation by Mr. W. P. Roop, on the effect of temperature on the magnetic susceptibility of gases. (*Science*, Dec. 13, 1912).

Sir George Howard Darwin, Plumian professor of astronomy and experimental philosophy at Cambridge University, distinguished for his contributions to our knowledge of the tides and kindred phenomena, has died at the age of sixty-seven years. (*Science* Dec. 20, 1912).

The Royal Society of Edinburgh proposes to commemorate in 1914 the tercentenary of the announcement of the discovery of logarithms by John Napier.

St. John's College has offered £500 as a contribution to the equipment of the Solar Physics Observatory on its installation at Cambridge.

New Observatory to be Built.—The trustees of Wesleyan University have voted to build an astronomical observatory at a cost of $60,000. (*Science* Nov. 15).

The 100-inch Reflector Delayed.—From a private letter we learn that the tests of the 100-inch disk of glass, which has been on the polishing machine for several months in the workshops of the Mt. Wilson Observatory at Pasadena, Calif., are showing that the disk is probably useless, as was feared, and the completion of the great reflector seems therefore to be only a hope of the distant future, depending on the securing of a more perfect disk of glass.

New Objectives ordered for the Cordoba Observatory.—From a private letter we learn that Professor C. D. Perrine, director of the Observatorio Astronomico de la Nacion Argentina, Cordoba, Argentina, S. A., has placed with the Alvan Clark & Sons Corporation orders for a 24-inch, 12-inch and several other objectives for that observatory. The work will be executed by the Messrs. Lundin, who have made many of the largest lenses sent out by the Alvan Clark & Sons firm.

The Annual Prizes of the Astronomical Society of Mexico.—Since the year 1903 the Astronomical Society of Mexico has been accustomed to give prizes (medals and diplomas) to the astronomers who have distinguished themselves in their astronomical work. Many North American astronomers have been awarded prizes, and among them we may mention; Messrs. Charles D. Perrine, George E. Hale, Percival Lowell, John E. Mellish and E. C. Slipher.

The 1912 prizes have been awarded as follows: To Mr. Sigurd Enebo, of Dombaas, Norway, for the discovery of Nova Geminorum No. 2. To Mr. Enzo Mora, of Sequals, Italy, for his tables for the phenomena of Jupiter's moons. To Mr. Ladislaus Weinek, of Prague for his beautiful drawings of the Moon.

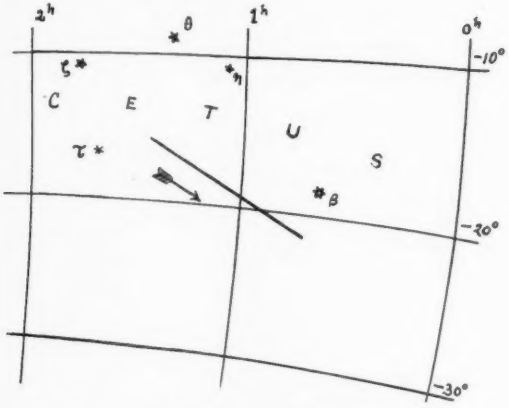
Dr. A. Von Maanen, in the *Astronomical Journal* No. 642, makes an addition to the extensive study which has been on the region of the Great Nebula in Orion. This contribution is the determination of the relative proper-motions of 162 stars in this region. These results are derived from plates taken with the 40-inch refractor and measured also at the Yerkes Observatory. The conclusion is that the proper motions of these stars are very small and that it is not possible to detect any common proper-motion among the stars in this region. Only three stars are found having a proper motion greater than 0″.100 annually. Incidentally this investigation tends to establish a superiority of long focus instruments over those of shorter focus for such refined measures.

Solar Radiation Records Wanted.—I would like to hear from any who have had experience in the use of actinometers, black bulb radiation thermometers, etc., and to know something of their results. This is of much importance right now and early communications will be much appreciated.

W. F. Carothers.

Houston, Texas.

A Large Meteor.—On November 27 at 6:46 C. S. T., the sky was heavily overcast, the stars β and η of Cetus and Fomalhaut being the only ones visible, and these only dimly. Suddenly the southern part of the sky was illuminated by bluish green light and I saw this large "fire-ball" ploughing its way through the clouds, the trail remaining visible for perhaps two or three seconds for a distance of eight or ten degrees. It was moving in a southeasterly direction in the constellation Cetus as indicated upon the chart.



A Large Meteor November 27, 1912.

Mr. Sullivan saw the momentary illumination from his house, but did not know what caused it. The time and direction coincided with the appearance of the meteor that I saw.

You may hear of this from other sources; if so, this report of it may be of interest also.

Florence B. Lee.

Williams Bay, Wis., Dec. 2, 1912.

An Exceptional and Brilliant Meteor.—Throughout the expanse of the star-lighted heavens, especially during a clear evening, one's attention is often attracted by the peculiar motion of a "shooting star" or meteorite. These often strike awe to the untutored person and cause him to watch their dissipating flight with a fearful wonder and occasional reverence.

On Saturday evening, November 23, 7:35 P. M., while walking home from my daily tasks, I witnessed one of the most beautiful sights I have ever experienced. A large meteor of exceeding brilliancy lighted up the south-western portion of the sky. First seen from a point sixty degrees above the horizon, it described an arc of about seventy-five degrees in length, approached diagonally to within five degrees of the earth, when it suddenly flew into many, revolving, illuminated pieces. No apparent report accompanied the rupturing of the object; however, a dull swish was audible as it passed swiftly through the atmosphere. A major portion, of the object, cleaved by the quickly produced heat and contact with the denser strata of atmosphere, was diverted from its original course and proceeded in an entirely new path. The trail left in the atmosphere much resembled a cissoid curve,

The meteor was doubly remarkable because of its innate color display. Having the apparent size of a six-inch globe, it possessed a green hue rarely seen in the combustion of tableaux powders. The color was characteristic of burning copper and would indicate the probable presence of either this element or barium in its composite mass. The direction of the meteor seemed to be from the Orion radiant since the apparent path would indicate that as a possible source. The total duration of the phenomena was barely three seconds (fortunately I kept my head within sufficient control to approximate the time.)

Although I have seen numerous other meteorites of varying colors and splendors, the one described above was, by far, the most noteworthy of them all.

HARPER F. ZOLLER.

Observatory, Urbana, Ill.
December 9, 1912.

Basis of Meridian Photometer Magnitudes.—In the Annals of Harvard College Observatory Vol. LXIV, No. VIII, the director describes the method employed to free the results of observations made with the Meridian Photometer from possible systematic errors, due to the unknown variability of the comparison stars. "The observations obtained during the years 1879 to 1892, with the 2-inch Meridian Photometer, were made by comparison of each star with the Pole-star. The danger of depending on the constancy of the light of a single star was fully recognized, and accordingly one-hundred stars, in declination between $+58°$ and $76°$, were selected, and measured on a number of nights. The two images of the Pole-star were generally compared at the beginning, middle, and end of each series, and measures were also made of several of the standard stars, both at upper and lower culmination. A discussion of the results in *Harvard Annals* **14**, 35, showed that no sensible variation of long period occurred in the light of the Pole-star. Although the reduction of the separate observations was only carried to tenths of a magnitude, it appeared that the residuals of groups of fifty series had an average value of only ± 0.02 magnitude. The small variation detected by Hertzsprung introduced an error in the final results that is almost imperceptible. Assuming the range to be 0.10 magnitude, the maximum error will be 0.05 and the average error, ± 0.03. Since each star was observed on at least three nights, the effect on the mean would be about ± 0.02. As the probable error of the final magnitudes is about ± 0.08, a correction for the variation in the Pole-star would affect the error, and consequently the final magnitude, on the average, by less than a hundredth of a magnitude." .....

"The Pole-star was not used as a standard in any of the later measures, which were made with the 4-inch Meridian Photometer. In the observations at Cambridge all the stars were compared with λ *Ursae Minoris*; in Peru the comparison star was σ *Octantis*. In all this work, the scale was determined mainly, or wholly, from the one hundred circumpolar standards. The effect of a slight variation of any one of these stars would, therefore, be insensible."

Catalogue of 8337 Stars.—Vol. LXVII of the *Annals* of the Harvard College Observatory contains the results of observations, made with the 8-inch Meridian Circle during the years 1888 to 1898, of the stars in the zone between $-9°\ 50'$ and $-14°\ 10'$ declination, which constituted the second assignment to Harvard College Observatory in the completion of the great *Astronomische Gesellschaft* catalogue. The observations were all made by Professor Arthur Searle and they were reduced under his direction. The star places are reduced to the epoch 1900.0

A Surprise in Mathematics.—Supposing an automobile and an aeroplane were racing around the world, the automobile running along, say, a meridian, a distance of approximately 25,000 miles and the aeroplane along the same meridian but 528 ft., or one-tenth mile above it, how much longer would the run of the latter be? No small handicap, one would think, but surprisingly insignificant, as a simple calculation will show, for the difference in the two paths will be found to be only about 3,300 ft, or a little more than half a mile in favor of the automobile, which is scarcely worth mentioning. (*Popular Mechanics*, November, 1912.)

Publications Received.

Annales de l'Observatoire Astronomique de Toulouse, Tome VI, Études des principales inégalités du mouvement de la lune qui dépendent de l'inclinasion, par Paul Gaubet.

Annales de l'Observatoire Astronomique de Toulouse, Tome VIII, Deuxième catalogue de Toulouse, par M. D. Saint-Blancat et M. E. Besson.

Bulletin de la commission météorologique du département de la Haute Garonne, Tome II, Fascic. 4, 1909.

Annales du Bureau des Longitudes, Tome VIII, L'Éclipse totale de Soleil du 29-30 août 1905.

Rapport sur les observatoires astronomiques de province, année 1911.

Connaissance des Temps, 1914.

Recherches sur les mouvement propres d'un groupe d'étoiles dan les environs de Corona Borealis, par N. Rasmuson.

Cambridge Observatory, Annual Report of the Observatory Syndicate 1911-1912.

Catalogue alphabetique des Livres, Brochures et Cartes, Bibliothèque de l'Observatoire Royal de Belgique, a Uccle, par A. Collard, Fascicule III.

Osservazioni Fotometriche di Stelle Variabili eseguite alle Specola di Padova, Nota di E. Padova.

Osservazioni sulle Comete 1911 *b*, *c*, *e*, *f*, *g*, fatti nella Specola di Padova, G. Silva ed E. Padova.

Per l'Osservazione della Stelle Variabili, G. B. Lacchini.

Osservazioni meteorologiche dell 'annata 1911, R. Perazzoli, Osservatorio della Università R. de Bologna.

Boletines de la Oficina Meteorológica Argentina, Feb. 1911.

The Secular Variations of the elements of the Orbits of the Four Inner Planets computed for the epoch 1850.0 G.M.T. by Eric Doolittle, University of Pennsylvania.

Zeichnungen des Planeten Mars, von Karl Bohlin.

Photometric Researches. The Algol-System Z Draconis, by R. S. Dugan. Contributions from the Princeton University Observatory, No. 2.

Meridian Beobachtungen von Sternen in der Zone 65°—70° nördlicher Declination von H. Geelmuyden und J. Fr. Schroeter, II Katalog für das Aequinoctium 1900.0.

Beobachtungen Veränderlichen Sterne, von Eduard Heis 1840-1877 und von Adalbert Krueger 1853-1892, herausgegeben von J. G. Hagen, S. J.

Le Idee di Lagrange, Laplace, Gauss, e Schiaparelli sull' origini delle comete. Ottavio Zanotti Bianco.

Teoria de la Aberación de la luz, Julio Garavito A.

Jahrbuch der Meteorologischen, Erdmagnetischen und Seismischen Beobachtungen in Pola, 1911, Band XVI.

Results of observations made at the Coast and Geodetic Survey Magnetic Observatory at Sitka, Alaska, 1909 and 1910.